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RESULTS OF TREATMENT OF MULTIPLE SCLEROSIS WITH DICOUMARIN

TRACY J. PUTNAM, M.D.

LUDWIG V. CHIAVACCI, M.D.

HANS HOFF, M.D.
AND
HYMAN G. WEITZEN, M.D.
NEW YORK

ETIOLOGY OF MULTIPLE SCLEROSIS

EVIDENCE has been accumulating over recent years which indicates that vascular destruction, or, more specifically, probably a thrombosis of venules, is an essential link in the chain of causation of multiple sclerosis and the related "encephalomyelitides."[1] This evidence may be summarized as follows:

1. Histologic pictures indistinguishable from the lesions of "encephalomyelitis" in the acute stage, and of multiple sclerosis when sufficient time has elapsed to permit gliosis to take place, have been produced experimentally in animals by the retrograde obstruction of cerebral venules[2] and by the intravenous injection of various coagulants, especially organ extracts.[3]

2. Similar lesions are also often seen in pathologic material of human origin, following spontaneous thrombosis of veins of a certain size from any cause, or compression of a pial vein by a tumor.[4]

From the Department of Neurology, Columbia University College of Physicians and Surgeons, and the Neurological Institute of New York.

1. (*a*) Putnam, T. J.; McKenna, J. B., and Morrison, L. R.: Studies in Multiple Sclerosis: I. The Histogenesis of Experimental Sclerotic Plaques and Their Relation to Multiple Sclerosis, J. A. M. A. **97**:1591-1595 (Nov. 28) 1931. (*b*) Putnam, T. J.: The Pathogenesis of Multiple Sclerosis: A Possible Vascular Factor, New England J. Med. **209**:786-790 (Oct. 19) 1933; (*c*) Evidences of Vascular Occlusion in Multiple Sclerosis and "Encephalomyelitis," Arch. Neurol. & Psychiat. **37**:1298-1321 (June) 1937; (*d*) Lesions of "Encephalomyelitis" and Multiple Sclerosis: Venous Thrombosis as the Primary Alteration, J. A. M. A. **108**:1467-1480 (May 1) 1937.

2. Putnam, T. J.: Studies in Multiple Sclerosis: IV. "Encephalitis" and Sclerotic Plaques Produced by Venular Obstruction, Arch. Neurol. & Psychiat. **33**:929-940 (May) 1936.

3. Hoefer, P. F. A.; Putnam, T. J., and Gray, M. G.: Experimental "Encephalitis" Produced by Intravenous Injection of Various Coagulants, Arch. Neurol. & Psychiat. **39**:799-812 (April) 1938.

(Footnotes continued on next page)

3. Thrombi, usually in venules and veins, have been observed in a large proportion of cases of acute "encephalomyelitis," and of the more acute lesions of multiple sclerosis, by various authors over the past half-century.[5] A recent survey disclosed that fresh thrombi were observed adjacent to fresh foci in 9 out of 17 cases of multiple sclerosis examined.[1c] Dow and Berglund [6] reported similar data. They observed thrombi in 9 of 60 lesions examined, usually adjacent to the more acute plaques. They chose to ignore the other types of evidence here presented, in concluding that the thrombi were the results of the parenchymal degeneration.

In 3 out of 5 cases of multiple sclerosis in which other organs of the body were available for study, thrombi were observed in them. In all 3 cases a recent exacerbation had occurred.[1c] Changes in the vascular architecture suggestive of the sequelae of an old obstruction are almost always demonstrable.[7]

Thrombosis of cerebral venules is almost regularly observed in cases of acute "encephalomyelitis"—of the postinfectious type, for example.[8] It occurs also with the experimental "encephalitis" provoked in monkeys by repeated injections of brain extract.[9]

4. The list of exogenous factors which tend to increase the coagulability of the blood and to produce thrombophlebitis—infection, trauma, pregnancy and chilling—as usually given (for example, by Howell [10]) corresponds closely with the list of exogenous factors which appear to precipitate the onset or exacerbations of multiple sclerosis (as listed, for example, by von Hoesslin [11]).

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4. Putnam, T. J., and Alexander, L.: Tissue Damage Resulting from Disease of Cerebral Blood Vessels, A. Research Nerv. & Ment. Dis., Proc. (1937) **18**:544-567, 1938.

5. Ribbert, H.: Ueber multiple Sklerose des Gehirns und Rückenmarks, Virchows Arch. f. path. Anat. **90**:243-260, 1882. Borst: Die multiple Sklerose des Zentralnervensystems, Ergebn. d. allg. Path. u. path. Anat. **9**:67-187, 1903-1904. Williamson, R. T.: The Early Pathological Changes in Disseminated Sclerosis, M. Chron., Manchester **19**:373-379, 1894.

6. Dow, R. S., and Berglund, G.: Vascular Pattern of Lesions of Multiple Sclerosis, Arch. Neurol. & Psychiat. **47**:1-18 (Jan.) 1942.

7. Putnam, T. J., and Adler, A.: Vascular Architecture of the Lesions of Multiple Sclerosis, Arch. Neurol. & Psychiat. **38**:1-15 (July) 1937.

8. Putnam, T. J., and Alexander, L.: Disseminated Encephalomyelitis, Arch. Neurol. & Psychiat. **41**:1087-1110 (June) 1939.

9. Rivers, T., and Schwentker, F. F.: Encephalomyelitis Accompanied by Myelin Destruction Experimentally Produced in Monkeys, J. Exper. Med. **61**: 689-702 (May) 1935.

10. Howell, W. H.: A Textbook of Physiology, Philadelphia, W. B. Saunders Company, 1933.

11. von Hoesslin, R.: Ueber multiple Sklerose: Exogene Aetiologie, Pathogenese und Verlauf, Munich, J. F. Lehmanns Verlag, 1934.

5. The clotting mechanism can be shown to be abnormally labile in cases of multiple sclerosis (Simon and Solomon,[12] Simon [13]). Obstructive changes have been observed in the retinal vessels, some of which might be interpreted as thrombotic (Rucker,[14] Franklin and Brickner [15]). Abnormalities can be observed in the capillaries of the nail bed in a majority of cases of multiple sclerosis (Gomirato,[16] Chiavacci and Putnam [17]).

THEORETIC BASIS FOR USE OF AN ANTICOAGULANT IN TREATMENT OF MULTIPLE SCLEROSIS

If the venous thrombosis often observed in cases of recent onset is the cause of the fresh lesion, and if thrombi occur in many parts of the body, without obvious local predisposing factors, it would seem reasonable to seek the next prior cause in some abnormality of the clotting mechanism of the blood.

The nature of the abnormality of the blood producing the thrombosis is obscure. Except for the lability of the clotting mechanism described by Simon and Solomon,[12] no disorder of the blood plasma has been demonstrated in cases of multiple sclerosis (nor has any been found in this investigation). There is some evidence which suggests that the tendency to thrombosis may in some sense be allergic (Putnam,[1d] Finley,[18] Ferraro [19]). Patches of demyelination, with "inflammatory" infiltrations in the acute stages, may be produced by injection of minute doses of tetanus toxin (Claude [20]; Putnam, McKenna and Morrison [1a]),

12. Simon, B., and Solomon, P.: Multiple Sclerosis: Effect of Typhoid Vaccine and of Epinephrine on Coagulation of Blood, Arch. Neurol. & Psychiat. **34**:1286-1291 (Dec.) 1935.

13. Simon, B.: Blood Coagulation in Disseminated Sclerosis and Other Diseases of Brain Stem and Cord, Arch. Neurol. & Psychiat. **48**:509-517 (Oct.) 1942.

14. Rucker, C. W.: Sheathing of Retinal Vessels in Multiple Sclerosis, Proc. Staff Meet., Mayo Clin. **19**:176-178 (April 5) 1944.

15. Brickner, R. M., and Franklin, C. R.: Visible Retinal Arteriolar Spasm Associated with Multiple Sclerosis: Preliminary Report, Arch. Neurol. & Psychiat. **51**:573-574 (June) 1944.

16. Gomirato, G.: Alterazioni dei capillari in malati di sclerosis multipla e loro significato, Riv. di pat. nerv. **53**:148-156 (Jan.-Feb.) 1939.

17. Chiavacci, L. V., and Putnam, T. J.: Capillaroscopic Observations in Cases of Multiple Sclerosis, to be published.

18. Finley, K.: Perivenous Changes in Acute Encephalitis Associated with Vaccination, Variola and Measles, Arch. Neurol. & Psychiat. **37**:504-514 (March) 1937.

19. Ferraro, A.: Pathology of Demyelinating Diseases as an Allergic Reaction of the Brain, Arch. Neurol. & Psychiat. **52**:443-483 (Dec.) 1944.

20. Claude, H.: Myélite expérimentale subaiguë par intoxication tétanique, Arch. de physiol. norm. et path. **29**:843-847, 1897.

by remote infection with Aspergillus fumigatus (Ceni and Besta [21]) and by repeated injection of organ extracts (Rivers and Schwentker,[9] Ferraro and Jervis [22]), as well as by single doses of coagulants. Cases in which an acute "encephalomyelitis" or an acute outburst or relapse of multiple sclerosis has followed an acute infection or the injection of protein material are of course common.

If the thrombosis is allergic in origin, it seems unnecessary to suppose that the tissue reaction is due to a local sensitivity, as lesions displaying an extreme "inflammatory" reaction may be produced by bland obstruction of veins or by a single injection of lung extract.[3] In any case, it would seem reasonable to suppose that the formation of local lesions might be prevented by decreasing the coagulability of the blood, as has been done in the case of experimental "encephalomyelitis" produced by intravenous injection of coagulants.[3]

LIMITATIONS OF ALL FORMS OF TREATMENT

In contemplating any form of treatment for multiple sclerosis, one point needs repeated emphasis.[23] Irrespective of theories of pathogenesis, neuropathologists are now well agreed that each sclerotic plaque goes through an acute stage, when the damage is at its height. The lesion is edematous and congested; the myelin is in the early stages of breakdown, and the surviving axis-cylinders show degenerative changes, suggesting impairment of function. At a later stage, the edema subsides; the debris is cleared away, and the axis-cylinders regain a much more normal appearance—all without special treatment. There is every reason to believe that the degree of recovery is fixed at the time the lesion is formed and that the surviving axis-cylinders will regain their function, at least to some extent. Further, it seems idle to hope that any form of treatment will induce regrowth of axis-cylinders once destroyed.

The clinical corollary of these fundamental pathologic facts is clear. It can scarcely be hoped that any form of treatment (beyond ordinary good hygiene) will materially improve the predetermined course of existing symptoms. The only substantial prospect of gain from specific treatment must be in the direction of protection against fresh relapses.

CHOICE OF AN ANTICOAGULANT FOR USE IN TREATMENT

With the apparent nature of the disease and the presumptive limitations of treatment in mind, the next problem would seem to be the choice

21. Ceni, C., and Besta, C.: Sclerosi in placche sperimentale da tossici aspergillari, Riv. sper. di freniat. **31**:125-135, 1905.

22. Ferraro, A., and Jervis, G. A.: Experimental Disseminated Encephalopathy in Monkey, Arch. Neurol. & Psychiat. **43**:195-205 (Feb.) 1940.

23. Putnam, T. J.: The Criteria of Effective Treatment in Multiple Sclerosis, J. A. M. A. **112**:2488-2491 (June 17) 1939.

of an anticoagulant. The properties of heparin and hirudin disqualify them from continuous use with a chronic disease. Cysteine has a feeble anticoagulant power and has seemed to have a corresponding tendency to prevent relapses in cases of multiple sclerosis.[24] A careful search was made through the literature for other anticoagulants (in 1937-1939) and none more suitable was found. The announcement of the discovery of dicoumarin (3,3′-methylene-bis-[4-hydroxycoumarin]) in 1941 appeared to furnish a possible solution of the problem.

Shortly after dicoumarin was released for clinical study its administration was begun in suitable cases (May 1942). Its use had to be discontinued for various reasons in some of the original cases, and others have been added at intervals. The drug has been administered in a total of 74 cases for periods up to forty-seven months. For the purposes of this paper, all the cases in which treatment has lasted less than six months, and all those in which the patient has not cooperated satisfactorily, will be disregarded. This leaves us with 43 cases for further analysis.

At the meeting of the American Neurological Association in May 1944,[25] Reese presented the results of treatment with dicoumarin, over a period of six months, in a series of 28 cases. His results will be more closely analyzed later ("Comment").

METHOD

In starting the clinical use of dicoumarin,[26] we were guided chiefly by the experience of Prandoni and Wright.[27] Patients were first hospitalized for a period of two weeks, and their blood prothrombin level was determined before and after the administration of dicoumarin. Hepatic and renal function tests were done, as well as complete blood studies of elements involved in the clotting mechanism. During the first fifteen months of this study, doses of 300 mg. of dicoumarin were given to patients daily for three days, followed by daily doses of 100 to 200 mg. Because of the high incidence of spontaneous hemorrhages in our early experience, it soon became apparent that the drug must be administered with more caution and in smaller doses. Consequently, during the ensuing years, while patients were hospitalized, they were given 150 mg. of dicoumarin for three days, the average daily dose thereafter being in the range of 50 to 100 mg. After discharge from the hospital the patients were given a maintenance dose of dicoumarin, which would be changed at any time, depending on the blood prothrombin level, which was determined at intervals of one to two weeks. Patients

24. Putnam, T. J., and Hoefer, P. F. A.: Cysteine Hydrochloride as an Anticoagulant for Clinical Use, J. A. M. A. **198**:502-509 (Oct.) 1939.

25. Reese, H. H.: Multiple Sclerosis and Dicumarol Therapy, Tr. Am. Neurol. A. **70**:78-84, 1944.

26. The dicoumarin was supplied by the Lederle Laboratories, Inc., during the period covered by this study; at present it is being supplied by E. R. Squibb & Sons.

27. Prandoni, A., and Wright, I.: Anti-Coagulants: Heparin and the Dicoumarin—3,3′ Methylene-Bis-(4-Hydroxycoumarin), Bull. New York Acad. Med. **18**:433-458 (July) 1942.

returned to the hospital at these intervals, at which time venous blood was drawn and subsequent changes in dosage of the medicament made, depending on the prothrombin level. We have found it convenient to have two mornings each week set aside for the drawing of bloods and laboratory work. We have found that the average daily dose required to maintain an adequate prothrombin level in patients receiving this drug over a prolonged period of time is in the vicinity of 50 to 100 mg. On this dosage hemorrhages are rare, but there is still some doubt whether such doses have served to maintain the prothrombin level as adequately as have the higher doses which we were accustomed to give early in the course of this study.

During the first eighteen months of this study, the blood prothrombin time was determined by the viper venom method of Russell,[28] using snake venom as a thromboplastin. The normal values with this method were 20 ± 3 seconds. Since then we have used the modification of the Link method proposed by Shapiro and associates for determining prothrombin time and find it to be more satisfactory, because of the constancy of results. In this method a specially prepared lung extract is used as thromboplastin,[29] and both whole plasma and plasma in the dilution of 1 : 8 is tested. The normal prothrombin times obtained by this method are 18 ± 3 seconds for undiluted plasma and 40 ± 10 seconds for the diluted sample of plasma. The average values obtained in cases of multiple sclerosis approximate the normal averages.

At present we attempt to elevate and maintain the prothrombin time to the vicinity of thirty seconds for the undiluted and ninety seconds for the diluted specimen by the administration of the appropriate doses of dicoumarin. Any sudden, disproportionate rise in the prothrombin time of the undiluted specimen portends an impending hemorrhage, as Shapiro and associates [30] have pointed out. Such an occurrence should lead to a marked reduction in dosage, or even withdrawal of the drug, for about four days, or until the time when a fall in prothrombin time permits further administration of the drug. Patients are cautioned about the use of salicylates in large doses while they are receiving dicoumarin because of the apparent tendency of the former series of drugs to elevate further the prothrombin time.[31]

RESULTS

The plan of evaluating our treatment was to determine the effectiveness of the daily administration of dicoumarin, in doses sufficient to elevate the prothrombin time of the blood to the desired levels, in preventing acute exacerbations or the appearance of new symptoms in a series of known cases of multiple sclerosis. Cases were chosen at random.

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28. Russell, H. K., and Page, R. C.: Prothrombin Estimation Using Russell Viper Venom: Simple Modification of Quick's Method, J. Lab. & Clin. Med. **26**:1366-1370 (May) 1941. Fullerton, H. W.: Estimation of Prothrombin: Simplified Method, Lancet **2**:195-196 (Aug. 17) 1940.

29. Purchased from the Maltine Company, 745 Fifth Avenue, New York.

30. Shapiro, S.; Sherwin, B.; Redish, M., and Campbell, H. A.: Prothrombin Estimation: Procedure and Clinical Interpretations, Proc. Soc. Exper. Biol. & Med. **50**:85-89 (May) 1942.

31. Fashena, G. J., and Walker, J. N.: Salicylate Intoxication: Studies on Effects of Sodium Salicylate on Prothrombin Time and Alkali Reserve, Am. J. Dis. Child. **68**:369-375 (Dec.) 1944.

We were limited in our choice only by the place of residence of the patient, which might make it impossible for him to return to the hospital at stated intervals for determinations of the prothrombin time.

It has already been pointed out that treatment was given in a total of 74 cases of multiple sclerosis, but that only 43 are included in this study, since in the remaining 31 cases continuous treatment for six or more months was not carried out. Experience soon showed that the effectiveness of the treatment depended in large part on the clinical type of the disease and that the cases fell naturally into two groups, which we have designated as follows:

Group A: Cases characterized by the appearance of recurrent, acute sharply limited attacks and remissions.

Group B: Cases in which chronic or persistent progression of symptoms occurred without well defined acute outbreaks of symptoms or periods of remission. The duration of symptoms in this group far exceeded that of the previous group. Disabling paraplegia was a common symptom.

In group A, the group with remissions, there were 27 cases. In 23 of these 27 cases the disease remained static during the period of treatment without the occurrence of any acute, fresh attacks, such as had occurred prior to the onset of treatment. In 2 cases slight functional improvement occurred during the course of treatment. Relapses occurred in 4 cases. In 2 of these 4 remaining cases it was impossible to adjust the prothrombin time to an adequate level even with large doses of dicoumarin, and relapses continued as before. In the other 2 cases, treatment was discontinued or greatly reduced for periods of several months, during which time acute symptoms appeared in both cases, with further functional impairment.

In group B, the group with slowly progressive disease, without well defined exacerbations and remissions, there were 16 cases. Of these treatment seems to have been without influence in 9 cases, the disease progressing at a rate similar to that prior to the treatment with dicoumarin. No observable change could be detected in the condition in the remaining 7 cases of this group during treatment. The condition in these cases was practically static during treatment, as it had been before. In some of the cases in this group, as in many cases of paraplegia of various origin, fluctuations in functional ability occurred from time to time. These episodes were not considered as exacerbations of the disease process, since they were not permanent or accompanied by evidences of new lesions.

These statistics may be stated in another manner. The aggregate number of months, with interruptions subtracted, during which all the 43 patients received adequate treatment was seven hundred and eighty-eight, or approximately sixty-six patient years. During this time no

relapses occurred. The records of these same patients show that they had had symptoms for an aggregate of two hundred and twenty patient years. Including the onset, there had been 94 definite fresh outbreaks in this group of patients, or an average of 0.6 per patient-year before treatment was begun.

Illustrative cases falling into one or the other of these two groups deserve a more detailed description. The following cases fall in group A.

REPORT OF CASES

D. R., a 30 year old woman, had four discrete bouts of paresthesias, impaired hearing, diplopia and difficulty with gait from August 1941 to January 1944, with no residual impairment of function. During these attacks she was confined to bed. Treatment with dicoumarin was started in January 1944, since which time there have been no acute attacks. There is no functional impairment, and the patient is able to go ice skating. There are persistent inequality and overactivity of tendon reflexes, without any other residual signs.

H. W., a 42 year old woman, had an attack of disseminated sclerosis in April 1944, with paresthesias, diplopia, impairment of vision, hemiparesis and coarse intention tremor. Treatment with dicoumarin was started in July 1944, at which time a complete spontaneous remission occurred. Treatment has been continued uninterruptedly until the present time, and there has been no recurrence of symptoms. Examination shows only a mild intention tremor on the left side.

P. R., a 27 year old woman, had left hemiparesis in 1939, lasting three months, and a relapse in 1943, with signs referable to the pyramidal tract, cerebellum and dorsal column in both lower limbs, associated with marked difficulty in walking. The latter symptoms cleared gradually over a period of months, and treatment with dicoumarin was started in August 1943, since which time she has shown no subjective evidence of relapse. Examination shows persistent signs of involvement of the dorsal column in both lower limbs. Subjectively the patient is completely free of symptoms.

A. S., a 16 year old girl, had an acute attack in February 1942 involving the spinal cord and bulb, with impairment of vision and mild papillitis. She had to be placed in a respirator, and tidal drainage of the bladder was instituted. The disease was progressive over a period of three weeks and treatment with dicoumarin was then started. Progression of symptoms stopped at once. Within a period of weeks she made an excellent spontaneous functional recovery. In June 1944 administration of dicoumarin was discontinued because of an intercurrent illness, and on resumption of treatment she was given smaller doses of the drug, with which her prothrombin time was barely elevated to twenty seconds. In August 1944, at this level, she had a relapse, with marked difficulty with gait. Over a period of several months, this cleared as the dose of dicoumarin was increased. There have been no relapses since.

V. B., a 23 year old woman, had an attack of vertigo, nausea and vomiting in June 1944, which cleared spontaneously in one month. In January 1945 she had left hemiparesis, left homonymous hemianopsia, diplopia and impairment of vision, which cleared completely over a period of two months. In June 1945 she had a recurrence of the hemiparesis. Administration of dicoumarin was started; her symptoms cleared completely, and she has been free of relapes since that time, while receiving dicoumarin. There is no impairment of function subjectively; she is able to carry out her work as a typist without any difficulty. Examination reveals

temporal pallor of one optic disk, overactivity of the tendon reflexes on the left and mild cerebellar signs in the left upper limb. Subjectively she is completely well.

S. S., a 28 year old housewife, had had four relapses since the onset of her disease with recurrent hemiplegia and ocular and vesical disturbance. There was residual difficulty with gait and vision. In January 1943 treatment was started with large doses of dicoumarin, and bleeding from the urinary tract developed, which was controlled by repeated transfusions of whole blood. Treatment was omitted for two weeks but was started again and continued until June 1944, when it was interrupted because the patient decided to go on a trip to Florida. During that time a relapse occurred, with marked ataxia and difficulty with gait. Treatment was resumed soon thereafter, and up to the present time her condition has not improved. She has had no further relapses, however.

R. T., a woman of 33, had recurrent attacks for three and a half years, with residual spasticity, but was able to walk with some difficulty and was otherwise well. Treatment was started early in 1944. After receiving dicoumarin for six months, without incident, she left for the Southwest and stopped treatment for two months. During this period she had a relapse; on returning she showed complete paraplegia and bilateral intention tremor and suffered from root pains and paresthesias. She has been confined to a wheel chair since, despite resumption of treatment with dicoumarin combined with a course of infusions of histamine but has had no further acute outbreaks.

In the following case the disease was of the chronic progressive type in which there was no apparent benefit from treatment.

W. B., a man of 38, had had only minor remissions during the eight years since the onset of the disease and prior to the beginning of treatment. His cerebellar symptoms were pronounced, with difficulty in walking, tremor of the head and upper limbs and difficulty with speech and deglutition. Early in 1943 treatment with dicoumarin was started. He had no remissions, and treatment did not seem to influence the course of his disease, his symptoms becoming progressively and slowly more marked. He had two series of histamine infusions, without any benefit. At present he is bedridden and almost totally incapacitated. On examination he shows signs of pronounced involvement of the cerebellum and the pyramidal tracts. Ocular signs are also present.

In another case with a progressive course an unusually high tolerance for dicoumarin was shown.

E. C., a 32 year old woman, was started on treatment with dicoumarin during her first admission to the Neurological Institute, in May 1942. Her symptoms began in 1939 with paresthesias, difficulty with gait and ocular and vesical disturbances. Examination revealed weakness and spasticity in both lower limbs with signs of involvement of the pyramidal tracts and posterior columns. There were bilateral atrophy of the optic nerve and nystagmus. After treatment with dicoumarin was started, it was found that the patient was able to tolerate usually high daily doses of the drug, as much as 150 to 200 mg. daily, without ever reaching the desired levels of prothrombin time or having a hemorrhagic episode. Hematologic studies and hepatic and renal function tests were all within the normal range. During the ensuing years she became slowly and progressively worse. She is now barely able to walk with assistance and has severe visual disturbance, so that she has difficulty in recognizing people. There is pronounced impairment of speech. Treatment with dicoumarin is being continued.

CLINICAL OBSERVATIONS ON EFFECTS OF PROLONGED ADMINISTRATION OF DICOUMARIN

Inasmuch as this is the first study of prolonged administration of dicoumarin some observations on the clinical effects of the drug so administered seem pertinent. During the course of treatment it is not unusual for prominence and enlargement of the superficial veins of the limbs to appear. Subcutaneous extravasations of blood with subsequent discoloration appear rather frequently, often as a result of trauma, which is likely to be unnoticed by the patient. This is no indication for discontinuing treatment and may be seen in patients whose prothrombin time is moderately elevated, to desirable levels. Bleeding from the gums and nasal mucosa, widely scattered showers of subcutaneous hemorrhages and subconjunctival extravasations of blood usually indicate elevation of the prothrombin time to dangerous levels, which may soon be followed by bleeding from the urinary tract if a drastic reduction in the dose is not carried out. Colicky pain in the loins with tenderness in the costovertebral angle uniformly indicates bleeding in the urinary tract, which is followed after a latent interval of twenty-four to forty-eight hours by grossly bloody urine. With such an experience, administration of the drug is curtailed and the patient hospitalized. Hematuria is controlled by from one to five transfusions of 500 cc. of whole fresh blood. During the early period of this study, when larger doses of dicoumarin were being used, 9 of a total of 17 cases were complicated by severe hematuria. Thereafter, there were only 4 more cases with such a complication, that is, a total of 13 cases. Abnormal urinary findings usually clear completely in about ten days after gross hematuria has ceased, with no residual impairment of renal function. We usually allow an interval of six to eight weeks after an episode of hematuria before starting treatment again. Large doses of vitamin K are given intravenously in conjunction with blood transfusions, to control hemorrhage, though we are unable to state how effective this measure is, since vitamin K was given routinely in all cases of hematuria. No other sites of hemorrhage occurred in this series of cases. There were no fatalities and no instances of allergic or other toxic effects from this drug.

The response of the blood prothrombin time to the administration of dicoumarin over a prolonged period differs in different persons. In some patients despite large doses of dicoumarin, an adequate prothrombin time could not be maintained. There were 2 such patients, and treatment did not give them protection.

COMMENT

There are few data in the literature concerning the incidence of relapses in cases of untreated multiple sclerosis. Von Hoesslin [11] gave

the following information, based on his own study of the records of a group of unselected cases:

> Among 516 cases, shorter or longer remissions were observed in 92, that is, in over 17 per cent. This includes not a few instances in which several remissions of long duration occurred. . . . In all cases in which I speak of a remission of a certain length, the remission was, of course, terminated by the beginning of a new outbreak. In 17 cases the remissions lasted three months to two years (often occurring repeatedly); in 10 cases, three to four years; in 10 cases, five to six years, in 16 cases, seven to ten years, and in 3 cases, eleven to twelve years. In 1 case in which the disease was of twenty-seven years' duration, 4 remissions occurred, 2 lasting four years and 2 five years. In a case in which the disease was of sixteen years' duration, 4 remissions occurred, of two, three, four and five years, respectively. In another case, remissions of eight years' duration occurred twice. Examples of especially long remissions are 4 of nineteen years' duration, 2 of sixteen and seventeen years, 3 of eighteen to twenty-one years, 2 of twenty-five years and 1 of forty-three years.

These figures are difficult to treat statistically, but it is obvious that no conclusion can be drawn from short series of cases observed over short periods. Moreover, in speaking of "remissions," von Hoesslin evidently means apparently complete restoration to health, not merely a period without exacerbation.

The only comparable series treated with dicoumarin is that of Reese,[25] reported at a meeting of the American Neurologic Association in May 1944. He treated 28 patients for periods up to six months. He reported subjective improvement in all his patients but saw no objective improvement. He found a rather marked fluctuation of the prothrombin level, perhaps because the dosage of dicoumarin was based on the patient's body weight rather than on the response. Some relapses occurred, but, to judge from the charts shown at the meeting, only during periods when the prothrombin time fell close to normal limits. On the whole, he apparently felt that the results of treatment were not sufficiently good to justify its continuance.

We have also observed subjective, and even objective, improvement in our cases but have been inclined to ascribe it to the normal healing process which clearly takes place in any lesion of the nervous system which damages, without destroying, nerve structures. Obviously, the maximum of restitution is obtained only when the general bodily condition is good (that is, in the absence of infection or malnutrition), and healing may be nullified by the extension of the pathologic process. If treatment with dicoumarin helps limit the spread of the damage, it may perhaps be said to permit recovery, rather than to produce it.

As far as we have been able to learn, no other forms of treatment have been statistically evaluated from the point of view of preventing the progress of the disease. Conclusions based on symptomatic improve-

ment following one or another form of treatment appear to be unreliable [23]

It is of interest that in 9 patients with advanced disease of the slowly progressive type, all of whom had paraplegia, gradual deterioration of the patient was not prevented. It has been pointed out [32] that paraplegia is one of the symptoms which carries the worst prognosis in cases of the untreated disease. In old, large, intense lesions of multiple sclerosis some mesodermal scarring occurs.[1c] It is possible that the slow downward course in such cases is dependent on secondary mesodermal fibrosis, rather than on an increase in the area of circulation impaired by progressive thrombosis.

TECHNIC OF TREATMENT

Much remains to be learned about the use of dicoumarin over long periods of time. The following points regarding its use have seemed important in our experience:

1. The patient, his family and the physician in touch with the case should be instructed in the purpose, method and dangers of the treatment (much as in the insulin treatment of diabetes). It should be constantly pointed out to all concerned that the treatment cannot be expected to produce improvement of symptoms, but merely to afford protection against serious future outbreaks. The danger of hemorrhage, and the steps to be taken should it occur, should be particularly emphasized. The patient should understand that the treatment confers protection only while it is used and that it will probably have to be continued the rest of his life.

2. Before starting the treatment, the physician in charge should assure himself that reliable determinations of the prothrombin time can be secured as often as necessary. We have found the method of Shapiro and associates the most reliable for the prothrombin time, and we use a specially prepared lung extract as thromboplastin. In this method, the clotting time of plasma diluted 1:12.5 is determined, as well as that of undiluted plasma.

The prothrombin time is determined before treatment is begun, twice the first week, weekly for the next month, then every two or three weeks. The dosage of dicoumarin is regulated to stabilize the prothrombin time of the undiluted plasma at about thirty seconds. If the clotting time of whole plasma rises to forty seconds, or that of diluted plasma to more than one hundred and twenty seconds, the dose should be omitted for at least four days and then begun at a lower level.

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32. Putnam, T. J.: The Diagnosis of Multiple Sclerosis and the Outlook for Treatment, M. Clin. North America **21**:577-593 (March) 1937.

3. The usual initial dose is 150 mg. This is immediately cut down to 50 mg. daily until a proper prothrombin time is reached. Fifty milligrams can then be given every other day, until the prothrombin time drops below thirty seconds, when the dose is increased again.

4. If hematuria occurs, administration of dicoumarin should at once be stopped and the patient put to bed. A transfusion should be given within twenty-four hours. In stubborn cases repeated transfusions, as many as five, have been found necessary. Administration of vitamin K, even intravenously, has not seemed to be of benefit.

SUMMARY

The evidence that sclerotic plaques arise as a result of venular thrombosis is reviewed.

The results of treatment of 43 patients with multiple sclerosis with dicoumarin (3,3'-methylene-bis-[4-hydroxycoumarin]) for periods varying from six months to four years is reported.

Doses of dicoumarin sufficient to raise the prothrombin time to thirty seconds continuously were administered, with constant laboratory control.

Twenty-five patients suffering from a remittent form of the disease were adequately treated without interruption for a total period of approximately sixty-one patient years. In this group no fresh symptoms or obvious acute outbreaks occurred. Most of the 16 patients with chronic progressive disease continued in their downward course.

The treatment of 2 patients was interrupted for one reason or another. The patients were free from new symptoms while taking treatment, but both had acute relapses when it was discontinued. In 2 patients large doses of dicoumarin failed to produce the expected increase in prothrombin time, and relapses occurred.

710 West One Hundred and Sixty-Eighth Street.

CEREBRAL BLAST SYNDROME IN COMBAT SOLDIERS

LIEUTENANT COLONEL HOWARD D. FABING *
MEDICAL CORPS, ARMY OF THE UNITED STATES

IN NOVEMBER 1944, arrangements were made with the surgeons of the First and Ninth United States Armies to send patients with blast injury to a designated general hospital specializing in neuropsychiatry in the Advance Section, Communications Zone, European Theater of Operations. It was hoped that a concentration of this clinical material might lead to a better understanding of the problem of blast injury. As a consequence, all patients with conditions diagnosed as blast injury, concussion, concussion neurosis, and the like, anywhere in forward echelons, as well as those with disturbances thought to warrant such a diagnosis by the admission section of this hospital, were examined.

Approximately 130 such patients were seen in November and December 1944, but clinical data on these cases were lost during the Battle of the Belgian Bulge, when the hospital had to be abandoned because of enemy action. Operations were resumed in January 1945, and this report deals with 80 patients representing consecutive admissions who were seen in subsequent months, up to the German capitulation, May 8, 1945. Patients in the second series came from combat elements engaged in the Roer-Rhine offensive, the Remagen bridgehead and the Battle of Western Germany.

METHOD OF STUDY

At the outset, it was decided that the entire subject of blast injury was so controversial that there was no guide to follow. All the pertinent facts in each case were tabulated, and careful examination was carried out in an attempt to answer the following questions: (*a*) Does a

* Dr. Fabing has returned to civilian status.

Capt. Bill H. Williams, M.C., assisted in selecting the cases for this study; Major Douglas Kelley, M.C., gave ether hypnosis in some cases, and Capt. Oscar Legault, M.C., contributed his observations on verbal hypnosis.

Capt. William P. Kelleghan, M.A.C., chief of the rehabilitation section of the general hospital, made a careful appraisal of the patients during their stay under him. Major Morris Kleinerman, M.C., recorded his estimates of these patients at the time of their discharge from the hospital.

Tec. 5 Rommie W. Tyndall, wardmaster in charge of these patients, aided in the abreaction technic, and Pfc. Albert B. Siewers devoted many months to the recording and summarizing of the data.

blast injury syndrome exist? (*b*) What are its clinical manifestations? (*c*) Is there any evidence of organic damage to the brain on clinical or laboratory examination? (*d*) What therapy appears efficacious? (e) What is the pathogenesis of blast injury?

THE BLAST SYNDROME

It was soon determined that a group of patients could easily be separated from the larger classifications of soldiers with acute combat exhaustion. These men gave a history of having been subjected to a nearby explosion, of being rendered unconscious by it and of having intractable headache, tinnitus and varying anxiety symptoms as a result. As a group they were tense, quiet, extremely noise-sensitive soldiers who were in constant search of relief from headache. They comprised 7.9 per cent of the total neuropsychiatric admissions for the entire period. During the first half of this series of campaigns, until the Remagen bridgehead was established, enemy opposition was definitely more effective than it was after that time. This is reflected in the fact that patients with blast injury comprised 11.8 per cent of all neuropsychiatric casualties from Jan. 27 to March 15, 1945, while they comprised only 5.1 per cent in the slightly longer period from March 15 to May 8, 1945. From this it may be deduced that the size of the problem of the blast syndrome varies with the tactical situation and is in all likelihood an index of the effectiveness of the enemy's artillery.

In the majority of instances there was agreement on the diagnosis by the various medical officers who had seen the patient in the evacuation chain. When the diagnosis of the blast syndrome (variously labeled blast injury, blast concussion and W. I. A. shell blast) was made by the battalion surgeon, it was seldom changed by other medical officers. In only 30 per cent was the diagnosis of blast injury made for the first time at this hospital.

Blast injury appeared to be oblivious of rank. The majority of the patients were privates, but so are the majority of men who fight. A large number of the patients studied were infantrymen, and in figure 1 *A* are compared the distribution according to rank of 80 patients with that of an equal number of riflemen. Although this affords only an approximation of the distribution of the normal combat population according to rank since other types of units have somewhat different tables of organization, it illustrates that blast injury occurs in all ranks and in proportions consistent with their approximate distributions. Officers were not included in this series, but they appear to suffer blast injury in accordance with their number, as do enlisted men and noncommissioned officers.

Blast injury does not occur especially among new replacement troops or in soldiers with long battle experience. Figure 1 *B* shows an even spread according to length of combat service, with a relatively large number of cases in troops with three to four months of combat experience. It was my impression that the average soldier on this front had been in combat about that long and that it was logical to expect a slightly higher incidence among men with that amount of combat duty.

The patients were examined a variable number of days after the blast experience. The shortest interval after blast was forty-five hours. For the most part they were seen within a fortnight of exposure to

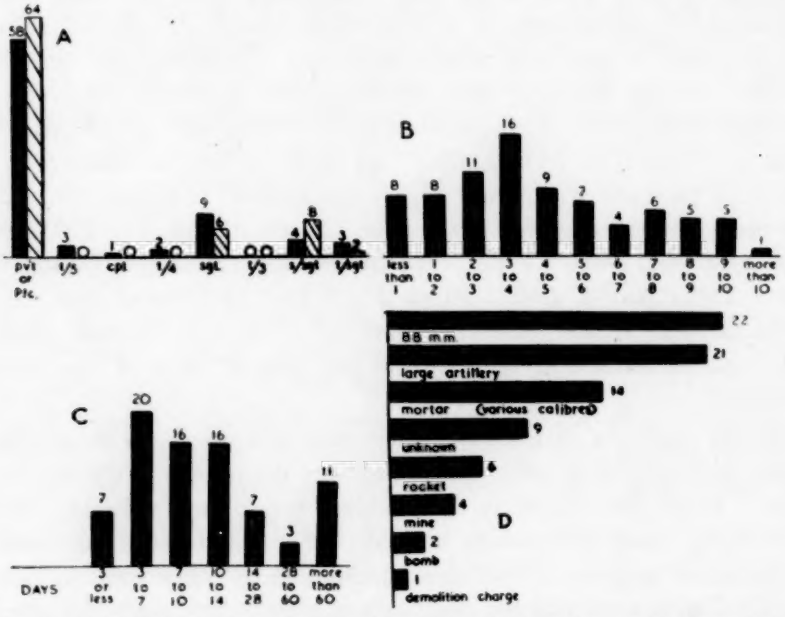

Fig. 1.—(*A*) Distribution according to rank of 80 patients with blast injuries (black rectangles) and that of an equal number of riflemen (hatchure). Distribution of patients with blast injury according to (*B*) number of months of combat, (*C*) time elapsed between blast and examination and (*D*) type of explosion.

blast. A small number had been blasted several months previously and were evacuated when symptoms became marked in subsequent action (fig. 1 *C*).

There seemed to be no specificity about the type of explosion causing blast injury. Some of the patients were at a loss to tell what the agent might have been. Eighty-eight millimeter shells were most frequently implicated; large artillery shells, next, and mortars, mines, bombs, etc., least often (fig. 1 *D*).

Each patient was questioned concerning the blast effect of one as compared with that of many shells. Approximately two thirds of

the men stated that "they were dropping stuff all around me, and one of them finally knocked me out." In the majority of the cases of multiple explosion, however, the soldier was able to recall a specific shell which finally rendered him unconscious.

CLINICAL MANIFESTATIONS

The unconsciousness caused by blast was studied with care. It is well known that there is often a long period of retrograde amnesia in cases of head injury, and my colleagues and I were interested in determining whether this was also true of patients with blast injury. Careful inquiry disclosed that it was not. About one fifth of the patients received blast injury from explosions which gave no warning noise (small mortar shells, mines, grenades), but of the remainder approximately three fourths recalled the whine of the oncoming shell. A smaller number recalled the visual component of the explosion—the flash—but it must be remembered that many soldiers are down in the bottom of holes with faces buried and eyes shut when shells explode nearby, and if such were not the case a larger number would probably see the flash. On the contrary, it is the rule that the sound of the explosion is never heard. This is in agreement with the oft-made assertion that "you never hear the one that hits you." It appears, then, that retrograde amnesia is confined to the sound of the explosion itself in cases of blast injury (fig. 2*A*).

The period of anterograde unconsciousness was extremely variable. Some soldiers were unconscious for only a minute or two, according to their reckoning, but this was not usually the case. Many were unable to put an exact time limit on this period, and some of our figures are approximations. The majority recovered consciousness in aid stations or hospitals. A small number had small islands of lucidity during the period of unconsciousness. Return to consciousness was abrupt and definite in some cases, while in others there was a period of what might be described as groping for consciousness. If an average of these data is computed, a period of anterograde unconsciousness of four hours emerges. An average is not so instructive as a median, however, since the few cases of abnormally long unconsciousness prejudice the average to a high figure. The median of one hour gives a better picture of the period of anterograde unconsciousness in blast injury (fig. 2*B*).

In a further inquiry into the unconsciousness produced by blast, it was often found that the patient regained his wits at some little distance from the place where the explosion took place. This was even the case when he found himself alone, when nobody had assisted him away from the place of the explosion. An inquiry was made into the patient's behavior during his amnesia, as told to him by his buddies, by the medical corps-

man who assisted him or by others. Data obtained in this way are extremely inaccurate, as further studies showed, but they led us to the conclusion that blast injury seldom produced motor inertia, i. e., coma, during the unconsciousness which followed it (fig. 3 *A*).

One of the great prejudices about the blast syndrome among medical officers in the field is the headache it produces. Before this study

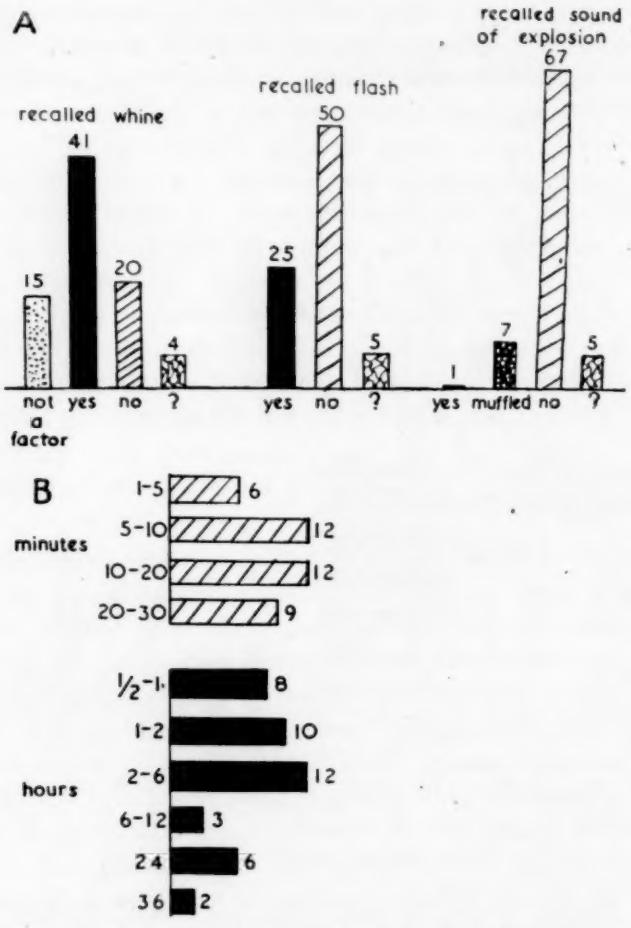

Fig. 2.—*A*, extent of retrograde amnesia; *B*, range of periods of anterograde unconsciousness, with an average of four hours and a median of one hour.

began, we were privy to many dogmatic statements on this subject made by colleagues during informal discussions. One officer asserted that the headache was always occipital; another, that it was always pounding; another, that is was bandlike, and so on. As a consequence, we determined to inquire into this symptom as thoroughly as possible. The results were anything but uniform. As for position, we found that the headache could be anywhere, that it was usually bilateral but could

be unilateral. Frontal and temporal headaches predominated, while others were a combination of many sites. Some were occipital, extending into the neck and shoulders. A few were generalized. No hemicrania of the classic migraine type was encountered (fig. 3 *B*).

The quality of the headache was no more specific than its location. About half were described as dull, while others were pounding or sharp, or shooting, and the occasional one was bursting in character. About half of the patients complained that they were never free of

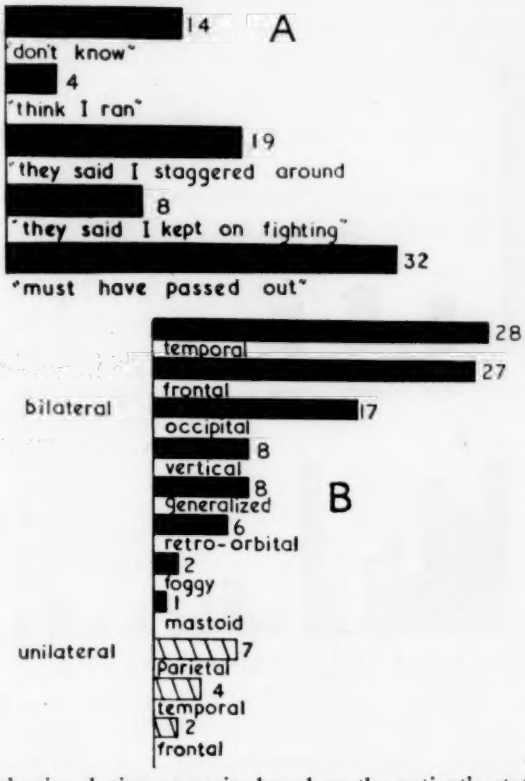

Fig. 3.—*A*, behavior during amnesia, based on the patient's statement on admission; *B*, types and location of headache.

headache, while the other half described their headache as intermittent. Of the continuous headaches, some were phasic in that they varied in intensity from hour to hour.

In summary, the headache in blast injury can only be described as a nonspecific, intractable one, varying in position, quality and persistence from case to case.

Tinnitus was an almost universal complaint in the cases of blast injury studied. In some cases it lasted only a matter of hours after the incident; in a few it was chronic and prolonged (fig. 4 *A*). The tinnitus was bilateral in more than one-half the cases and confined to one ear in

the others. In some cases of bilateral tinnitus one ear stopped ringing before the other.

Tinnitus was not the intractable symptom that headache was in these patients, although a paratrooper who was blasted at Nijmegen, Netherlands in October 1944 still complained of tinnitus the following March. About one third of the patients stated that their ears had stopped ringing by the time they were examined by us (fig. 4 *B*).

The anxiety symptoms of which these patients complained were of the kind met with in other neuroses of combat.[1] There were significant

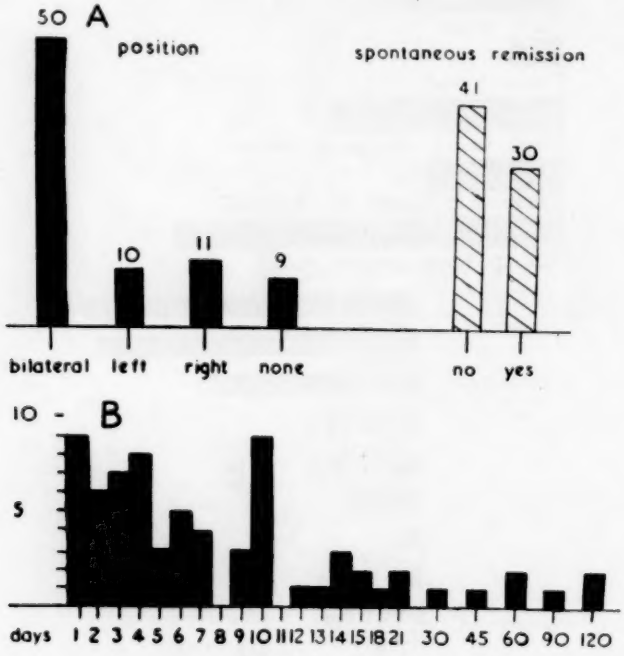

Fig. 4.—*A*, type and laterality of tinnitus; *B*, duration of tinnitus.

differences, however. The sensitivity to noise of which they complained was pitiably acute. One evening a recently admitted patient asked

1. Sargant, W., and Slater, E.: Acute War Neuroses, Lancet **2**:1 (July 6) 1940. James, G. W. B.: Psychiatric Casualties: Hints to Medical Officers in the Middle East Forces, G. H. Q., M. E. F. (British), revised edition, London, His Majesty's Stationery Office, September 1942. Love, H. R.: Neurotic Casualties in the Field, M. J. Australia **2**:137 (Aug. 22) 1942. Early Recognition and Treatment of Neuropsychiatric Casualties in the Combat Zone, Circular Letter no. 176, War Department, J. A. M. A. **123**:705 (Nov. 13) 1943. Raines, G., and Kolb, L. C.: Combat Fatigue and War Neurosis, U. S. Nav. M. Bull. **41**:923 (Sept.) 1943. Zeligs, M. A.: War Neurosis: Psychiatric Experiences and Management on a Pacific Island, War Med. **6**:166-172 (Sept.) 1944. Kubie, L. S.: Manual of Emergency Treatment for Acute War Neuroses, ibid. **4**:582 (Dec.) 1943.

permission to attend a U. S. O. show at the hospital. In a few minutes he was back in the ward; when asked why he had not remained for the show, he said that he took one look at the bass drum and realized that he would never be able to endure its cacophony. Slamming doors, rolling food carts, messhall noises, radios and even animated conversations brought complaints. Airplanes overhead, especially buzz bombs in their flight, brought to these patients a mixture of terror and anguish which beggars description. In a goodly number this was accompanied with motor startle patterns. Vertigo, not of a patterned kind, such as is seen in Ménière's disease and other aural disturbances, but a floaty dizziness, was a widespread complaint. Severe battle dreams seemed to occur as frequently in this group as in the rest of the patients with acute combat neuroses. A subjective feeling of tremulousness,

Fig. 5.—Distribution of anxiety symptoms.

of which the vernacular word "jitters" seems to be the most descriptive, was frequent. A fast, fine tremor of the hands, sometimes of the lips and legs, similar to that met in cases of hyperthyroidism, was also frequent. Gastric disturbances led the list of visceral dysfunctions. Although the complaint of clouding of the sensorium was not often voiced, it was obvious that it occurred frequently. These patients did not read, follow radio news, play cards and behave generally like a group of soldiers in a ward of an Army hospital. They wandered alone, lay on their cots or just talked a bit to the man in the next cot. The pall of apathy met in a ward of schizophrenic patients was not present, to be sure; yet normal animation was missing (fig. 5).

A kind of generalized muscular soreness was found in about one-half these patients. By the time they reached this hospital the complaint was no longer present, but they said that it was often severe for one or

two days. They described it vividly—it was like being whipped with a rubber hose or like receiving a thorough beating with a rifle butt.

Evidence of spontaneous hemorrhage has often been regarded as a frequent accompaniment of the blast syndrome. Some observers even feel that the diagnosis cannot be made in the absence of such bleeding. In our series this criterion did not hold. Nosebleed occurred in 25 per cent and bleeding from the mouth in 10 per cent. Bleeding from the mouth may have been from the lungs or from the upper respiratory tract, but roentgenologic evidence of diffuse pulmonary hemorrhage was not found. Bleeding from the ears was reported in 3 cases; ear drums were ruptured in 2 other cases. No hemorrhage or fissures were seen in the skin, or no petechiae in the eyegrounds, in this group. It is our conclusion, then, that evidence of spontaneous bleeding is the exception, rather than the rule, in cases of the blast syndrome.

Approximately 20 per cent of our patients showed evidence of other injury, such as minor lacerating wounds from shrapnel, abrasions, contusions and burns, acquired at the time of blast. It is probable that a large number of patients who are blasted receive severe wounds at the same time and are evacuated via surgical channels. We have seen such patients after successful treatment of wounds, and some are included in this series. The symptoms of headache and anxiety persist, and in some cases chronic tinnitus remains. It is impossible to estimate how many cases of such conplications exist, but it appears certain that they do. The statement that the actually wounded do not have neuropsychiatric complaints has proved a false one in this theater, and this is especially true of soldiers who have suffered blast injury.

CLINICAL AND LABORATORY EVIDENCE OF ORGANIC DAMAGE TO THE BRAIN IN BLAST INJURY

Clinical neurologic examination was carried out on all these patients. Not one showed any evidence of focal damage to the central nervous system: No disorders of the cranial nerves, no motor disturbances, no pathologic reflexes, no sensory deficits and no cerebellar or extrapyramidal signs could be elicited. This was not true of signs of "functional" lesions. Three patients had a stammer; 1, a hysterical titubation of the head; 1, a pseudoparkinsonian tremor of the hands; 1, a wide-based, disorganized gait, without evidence of disease of the cerebellum or the posterior column; 1, a hysterical ankylosis of the left knee, and 1, fleeting right hemiparesis without orthodox neurologic signs, which cleared spontaneously five days after the blast. Clinical neurologic examination, then, was not productive of abnormal signs, except those of a type met with in patients with conversion hysteria.

An electroencephalograph was not available to us, and, unfortunately, I am unable to add the results of the test to these data.

Lumbar puncture was done in every case with the use of local anesthesia and with the patient in the horizontal position. A 20 gage needle and a water manometer were used. In all cases the spinal fluid pressure fell within the normal span of 70 and 180 mm. of water as defined by Merritt and Fremont-Smith [2] (fig. 6*A*). The white blood cell count was also within the normal range as defined by the aforementioned authors (fig. 6*B*).

Counts of red cells were made without centrifugation and without treating the fluid otherwise (fig. 6*C*). Two fluids were clear but contained 38 and 60 red cells per cubic millimeter, respectively. In another, containing 13 red cells per cubic millimeter, the bleeding was

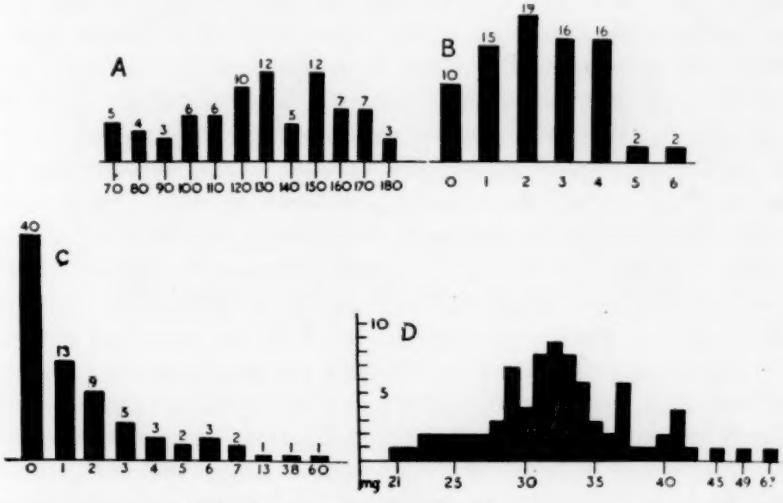

Fig. 6.—Results of study of cerebrospinal fluid. *A*, pressure; *B*, white cell count per cubic millimeter; *C*, red cell count per cubic millimeter, and *D*, protein content per hundred cubic centimeters.

obviously the result of a traumatic tap, as noted at the time of puncture. The rest of the fluids may be considered to have been free from blood.

In order to rule out the possibility that bleeding might have taken place prior to examination and that the red blood cells had been laked or dissolved at the time the puncture was performed, each specimen was subjected to a benzidine test. No free hemoglobin was found in any specimen except in 2 with the abnormally high red cell counts. The failure of this sensitive test to show evidence of free hemoglobin in the fluids was further evidence against bleeding within the central nervous system in these cases.

2. Merritt, H., and Fremont-Smith, F.: The Cerebrospinal Fluid, Philadelphia, W. B. Saunders Company, 1937.

The protein content of all specimens was determined by the method of Johnson and Gibson.[3] It was found to be within the normal span of 20 to 45 mg. per hundred cubic centimeters in all but 2 specimens, those with the abnormal red cell counts. The specimen containing 38 red cells per cubic millimeter had 49 mg. of protein, and that containing 60 red cells had 62 mg. of protein, per hundred cubic centimeters (fig. 6*D*).

Colloidal gold was not available to us, but the mastic test was carried out on all specimens of spinal fluid. The curves were normal throughout the series.

SUMMARY OF CLINICAL AND LABORATORY DATA: TENTATIVE DEFINITION OF BLAST SYNDROME

An appreciable group of combat soldiers become casualties as a result of nearby explosions. Blast injuries occurred among all ranks and in new replacements as well as in combat-wise troops. The type of explosive agent is not specific, varying from large caliber artillery shells to grenades. Some soldiers become casualties after a single explosion nearby, while others succumb during a barrage. The explosion produces a rather specific kind of unconsciousness, characterized by a retrograde amnesia for the sound of the explosion and an anterograde period of unconsciousness which is extremely variable, but which may be said to last an hour in the usual case. During the period of unconsciousness the patient is seldom comatose but usually carries out some motor activity, according to report. On regaining consciousness he complains of intractable headache, which may be almost anywhere in his head, may be constant or phasic or intermittent and may have any quality, such as dull, sharp or pounding. He complains of tinnitus as well, but this tends to disappear in a matter of days except in the unusual case. In addition, he complains of any of a number of symptoms of anxiety, chief among which are sensitivity to noise, vertigo, startle, "jitters," battle dreams and gastric disturbances. Almost half of these patients complain of a generalized somatic soreness for a day or two after blast. They show no evidence of focal damage to the central nervous system on neurologic examination. Few of them show evidence of bleeding from any of the orifices. The spinal fluid pressure is not increased, and except in rare instances bleeding does not occur into the spinal fluid. The fluid has no increase in white blood cells, and the protein content is normal except in the rare case in which bleeding has occurred.

From these data, a tentative definition of the disorder can be constructed as follows: The blast injury syndrome is that morbid condition

3. Johnson, G. W., and Gibson, R. B.: The Determination of Blood Plasma and Spinal Fluid Proteins, Am. J. Clin. Path. (Tech. Supp.) **8**:22 (Jan.) 1938.

which results from the nearby explosion of one or more shells and causes the following tetrad of symptoms: (1) unconsciousness, with retrograde amnesia for the sound of the explosion and of varying anterograde duration, but persisting an hour in the usual case; (2) protracted, nonspecific headache; (3) tinnitus, which usually does not persist, and (4) diffuse anxiety symptoms.

CRITICISM OF THE FORMULATION

This definition of the blast syndrome, based on our data, gives rise to a series of questions. Is this series of cases a highly selected one? Are the patients with more serious blast injury evacuated through surgical channels and therefore not included in a series such as this? Does visceral damage occur in blast injury? In what way does blast kill the patient? Are cerebral changes present which are too subtle to be found by the methods used in this investigation? Do petechial hemorrhages occur in the brain substance, as has often been stated?

For answer to the first of these questions it is best to turn to experience in the field. In discussions with officers and noncommissioned officers of the line; with medical officers in battalions, in collecting and clearing companies and in Army exhaustion centers, and with divisional psychiatrists, the sum of impressions gained is that the foregoing description of blast injury is a valid one. Personal observations in divisional areas, together with experience during the Battle of the Belgian Bulge, in December 1944, confirm it as well. In the period last mentioned our hospital became an almost front line installation, owing to the tactical situation. Three thousand casualties passed through our hands in four days. The many cases of blast injury seen at that time conformed to the criteria defined here. Patients with blast injury who are also wounded are evacuated through surgical channels necessarily, but their symptoms of blast injury are identical with those of unwounded men.

Visceral damage occurring as a result of blast was studied by Hooker [4] in 1924, and in the early years of the present war a number of reports by British investigators were made. Pulmonary lesions are most common and vary from scattered areas of interstitial bleeding to massive hemorrhage involving large portions of the lung.[5] A series

4. Hooker, D. R.: Physiologic Effects of Air Concussion, Am. J. Physiol. **67**:219 (July) 1924.

5. (*a*) Hadfield, G., and others: Blast from High Explosive; Preliminary Report on Ten Fatal Cases, with an Identification and Estimation of Carboxyhemoglobin in Formol-Fixed Material, Lancet **2**:478 (Oct. 19) 1940. (*b*) Falla, S. T.: Effect of Explosion-Blast on Lungs, Brit. M. J. **2**:255 (Aug. 24) 1940. (*c*) Osborn, R. G.: Pulmonary Concussion ("Blast"), ibid. **1**:506 (April 5) 1941.

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of experiments by Zuckerman[6] give evidence that these pulmonary lesions are brought about by the direct force of the positive pressure wave of the blast on the thoracic wall rather than by tracheal transmission. Roentgenologic evidence of blast injury to the lung has been presented.[7] Hemoperitoneum with rupture of abdominal viscera, hemopericardium, mediastinal hemorrhage and hematuria have been described. It appears that abdominal lesions are more frequent with immersion blast than with air blast.[8] These lesions were not seen in our patients, although 2 of them gave histories of coughing up bloody sputum, apparently pulmonary in origin. No roentgenologic confirmation of pulmonary hemorrhage was found in our cases. It is probable that patients with frank visceral lesions due to blast are in the minority and that they would not be evacuated through neuropsychiatric channels.

Blast injury undoubtedly kills combat soldiers on occasion. The average battalion surgeon who has had continuous duty in the battles of France, Belgium and Germany can usually recall 1 or 2 cases of death following blast without external evidence of trauma. Srodes,[9] psychiatrist of the First United States Army, was unable to obtain any

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(*d*) Hadfield, G., and Christie, R. V.: A Case of Pulmonary Concussion ("Blast") Due to High Explosive, ibid. **1**:77 (Jan. 18) 1941. (*e*) O'Reilly, J. N., and Gloyne, S. R.: Blast Injury of Lungs, Lancet **2**:423 (Oct. 11) 1941. (*f*) Rose, T. F.: Lung Blast, M. J. Australia **1**:784 (June 28) 1941. (*g*) Palma, J., and Enright, W. M.: Blast Injury (Concussion) of Lungs, U. S. Nav. M. Bull. **40**:963 (Oct.) 1942. (*h*) King, J. D.: Concussion of Lung, Surgery **12**:415 (Sept.) 1942. (*i*) Booth, F. J.: Cases of Lung Injury Following Exposure to Blast and Nitrous Fumes, Australian & New Zealand J. Surg. **12**:72 (July 1942. (*j*) Tunbridge, R. E.: Cause, Effect and Treatment of Air Blast Injuries, War Med. **7**:3 (Jan.) 1945. (*k*) Brubaker, R. E.: Air Blast Injury, Bull. U. S. Army M. Dept., April 1945, no. 87, p. 110.

6. Zuckerman, S.: (*a*) Experimental Study of Blast Injuries to Lungs, Lancet **2**:219 (Aug. 24) 1940; (*b*) in Discussion on Problems of Blast Injuries, Proc. Roy. Soc. Med. **34**:171 (Jan.) 1941.

7. Thomas, A. R.: "Blast Chest": Radiologic Aspect of Pulmonary Changes Following Exposure to High Pressure Waves, Brit. J. Radiol. **14**:403 (Dec.) 1941.

8. Williams, E. R. P.: Blast Effects in Warfare, Brit. J. Surg. **30**:38 (July) 1942. Travers, L. G.: Multiple Injuries Resulting from Bomb Explosion, Australian & New Zealand J. Surg. **12**:74 (July) 1942. Wakeley, C. P. G.: Blast Injuries, Glasgow M. J. **139**:91 (April) 1943. Wilson, J. V., and Tunbridge, R. E.: Pathological Findings in a Series of Blast Injuries, Lancet **1**:257 (Feb. 27) 1943. Fulton, J. F.: Blast and Concussion in Present War, New England J. Med. **226**:1 (Jan. 1) 1942. Cameron, G. R.; Short, R. H. D., and Wakeley, C. P. G.: Pathological Changes Produced in Animals by Depth Charges, Brit. J. Surg. **30**:49 (July) 1942. Yaguda, A.: Pathology of Immersion Blast Injury, U. S. Nav. M. Bull. **44**:232 (Feb.) 1945. Theis, F. V.: Atmospheric and Immersion Blast Injuries, War Med. **4**:262 (Sept.) 1943.

9. Srodes, W.: Personal communication to the author.

valid autopsy material. Krohn, Whitteridge and Zuckerman [10] summarized this problem in experimental studies as follows:

> There are a number of ways of being killed by blast, of which total disintegration of the body is the extreme case met with very close to an explosion. Those animals which are immediately killed without external injury presumably die from that undefined entity known as "primary shock" resulting from extensive visceral lesions. Some animals in this group have the trachea and main bronchi completely blocked by solid blood-clot. Whatever other factors may have contributed to their deaths, further air-entry would have been impossible. Most animals which have died more than a short interval after exposure usually had blood-stained froth in their mouth and nose and have died of pulmonary œdema. Others die because of continued hæmorrhage due to damage to an abdominal organ. Hæmorrhage into the ventricles of the brain has occasionally been observed in rabbits but not in other species. The other changes that have been observed in the nervous system are so slight that they can hardly be regarded as fatal. No direct fatal interference with cardiac function has been observed.

There seems to be little evidence to support the view that death following blast is due to cerebral lesions. A solitary human case was reported by Ascroft [11] in which he observed a curious lilac pink appearance of two areas of the cortex, which proved microscopically to contain widespread capillary hemorrhage. Stewart, Russel and Cone [12] described changes in the brain of a pheasant which died in the vicinity of a bomb crater. On the other hand, Hadfield [5a] was unable to find any overt lesions of the brain in 10 autopsies, and in a later report,[13] on 30 cases, he did not mention pathologic changes in the brain. O'Reilly and Gloyne [5e] also observed no cerebral lesion. Zuckerman [6b] subjected monkeys to fatal blast pressures of 110 pounds per square inch (7.7 Kg. per cubic centimeter) and was unable to find changes in the cortex, midbrain, pons or medulla in any of the animals. The conclusion [14] that a shell blast sufficiently serious to damage the brain would prove fatal because of pulmonary or abdominal trauma appears to be a valid one.

Evidence of damage to the central nervous system in cases of nonfatal injury is equally meager. Garai [15] reported a case in which there were

10. Krohn, P. L.; Whitteridge, D., and Zuckerman, S.: Physiologic Effects of Blast, Lancet **1**:252 (Feb. 28) 1942.

11. Ascroft, P. B.: Blast Injury of Lungs, with Curious Lesion of Cerebrum, Lancet **1**:234 (Feb. 20) 1943.

12. Stewart, O. W.; Russel, C. K., and Cone, W. V.: Injury to Central Nervous System by Blast: Observations on the Pheasant, Lancet **1**:172 (Feb. 8) 1941.

13. Hadfield, G., in Symposium on Problem of Blast Injuries, Lancet **1**:110 (Jan. 25) 1941.

14. Further Experimental Studies of Blast Injuries, editorial, J. A. M. A. **121**:1220 (April 10) 1943.

15. Garai, O.: Blast Injury: Non-Fatal Case with Neurological Signs, Lancet **1**:788 (June 17) 1944.

impaired pupillary reaction on the right and a transient extensor plantar response on the left. Abbott, Due and Nosik [16] observed subdural hematoma in 2 victims of blast injury and "subdural effusions" in 8 others at operation.

It is quite possible, as Mott [17] suspected, that subtle changes may occur in the nervous system following blast which cannot be discovered by crude methods of clinical and laboratory examination, such as those used in this study. The absence of an electroencephalographic record in these cases is regrettable, but we suspect that nonspecific brain wave patterns would be found, as was apparently the case in British studies on human subjects.[18] Furthermore, Krohn and his associates [10] obtained electrocorticograms from monkeys and cats (under light pentobarbital anesthesia) subjected to blast. In some they found no electroencephalographic changes whatever, even though the animal died as a result of the blast. In others there was a suppression of cortical activity for a period up to seven minutes after blast. No late electroencephalographic changes were found when observations were made several hours after blast. The authors concluded that the occasional transient changes observed could be related to cortical anoxemia resulting from general circulatory changes following the blast.

As for the claim that petechial hemorrhages occur in cases of blast injury, we have been forced to reject it. We are left with 2 cases out of 80 in which even minute amounts of blood and increased protein were present in the cerebrospinal fluid. This incidence of bleeding is too small to be taken seriously as evidence of multiple petechial hemorrhages in the brain. Nor is the argument tenable that such hemorrhages may be present but may not make themselves evident in the fluid: The cerebrospinal fluid is in too close approximation to all the brain substance to permit such an assumption. If such hemorrhages occurred with any consistency in cases of blast injury, they would be evident more often in the cerebrospinal fluid in the early stages.

In summary, in the series of cases in this study there appears to be no serious visceral pathology. The lack of evidence of cerebral damage appears to be consistent with the results of other studies, and it may be inferred that this series is representative of the cerebral type of blast injury. Klemm,[19] in a study of 36 patients seen ten to twenty days after blast injury, and Anderson [20] described similar syndromes.

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16. Abbott, W. D.; Due, F. O., and Nosik, W. A.: Subdural Hematoma and Effusions as Result of Blast Injuries, J. A. M. A. **121**:664 (Feb. 27); 739 (March 6) 1943.

17. Mott, F. W.: Lettsonian Lectures, Lancet **1**:331 (Feb. 12); 441 (Feb. 26); 545 (March 11) 1916.

18. Williams, D.: Personal communication to the author.

THERAPEUTIC TRIALS

The therapeutic effect of lumbar puncture in cases of blast injury proved to be nil. Analgesics, such as acetylsalicylic acid and codeine, brought only temporary relief, and then only occasionally. Sedation was of temporary benefit. Continuous narcosis therapy was not of value. Modified insulin therapy, as described by Sargant and Slater,[21] failed to help these patients. The logic of desperation, and an almost mystical belief in what the drug can accomplish on occasion, even led us to try potassium iodide in some of our cases, but it was ineffective.

We stumbled on a new approach to therapy during an inquiry into the nature of the unconsciousness in these patients. Since all other methods had failed to disclose evidence of organic damage to the brain, we felt that a study of the period of unconsciousness following blast might shed further light on this question. We proceeded on the assumption that the patient would not be able to recover his memory for the period of unconsciousness if his brain was organically damaged by the blast but that he would be able to do so if there was no such damage. Consequently, chemical hypnosis was performed in a few of our early cases by Capt. David Turnoff, M. C. Sodium pentothal[22] was used. He found that in this drug-induced state of semisleep the patients were able to relive the experience vividly and to recall the events in an accurate manner. Thus, it was proved that the loss of memory was of recoverable type, similar to that seen in hysterical amnesia, as Denny-Brown reported.[23] It was noted further that some of these patients reported a dramatic and gratifying relief of headache, tinnitus and anxiety after this procedure.

With the assistance of Major Douglas Kelley, M.C., it was demonstrated that this recovery of amnesia with consequent therapeutic effect could also be brought about by use of ether by inhalation, after the technic of Palmer,[24] as well as with sodium pentothal.

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19. Klemm, R. A.: Atmospheric Blast Concussion: Medical Aspects, U. S. Nav. M. Bull. **44**:1228 (June) 1945.

20. Anderson, E. W.: Psychiatric Syndromes Following Blast, J. Ment Sc. **88**:328 (April) 1942.

21. Sargant, W., and Slater, E.: An Introduction to Physical Methods of Treatment in Psychiatry, Edinburgh, E. & S. Livingstone, 1944.

22. (*a*) Horsley, J. S.: Narco-Analysis, London, Oxford University Press, 1943. (*b*) Grinker, R. R., and Spiegel, J. P.: War Neuroses in North Africa, New York, Josiah Macy Foundation, 1943. (*c*) Brenman, M., and Gill, M. M.: Hypnotherapy, ibid., 1944.

23. Denny-Brown, D.: "Shell Shock" and Effect of High Explosives, J. Lab. & Clin. Med. **28**:509 (Jan.) 1943.

24. Palmer, H.: Personal communication to the author. In June 1944 Major Palmer demonstrated chemical hypnosis with ether to the staff of the general hospital where this study was made.

The early promise shown by these therapies led us into a more careful study of them. Too often the technic failed, but the occasional gratifying success was stimulating. For a while we felt that best results were obtained by producing strong emotional abreaction under the action of the drugs, with the patient struggling and shouting to extricate himself from the situation. At another time we believed that the essential element in therapeutic success was the production of tears, and we used every possible method to make the patient cry during the therapeutic session, as Palmer had advocated. Follow-up study, however, showed that best results were obtained when the patient recalled the amnesic period in all its details while under the drugs and when this became integrated into consciousness after the treatment.

Since many of the sessions were long, requiring repeated questioning for details when the patient was under the drug, ether was abandoned in favor of sodium pentothal. We found that it was more difficult for the patient to talk with a mask over his face and that the proper level of chemical hypnosis was more difficult to maintain with the inhalant than with the intravenously injected barbiturate.

After selecting sodium pentothal, administered intravenously, as our drug of choice, we continued to encounter difficulties. Often the patient was able to give a clear account of his amnesic period while under the drug, but after he returned to the ward from the treatment room he fell asleep, and on wakening he had no recall whatever for the details of his amnesia. We began to keep careful notes on the material uncovered during the treatment session, and these were read back to the patient after he was fully awake. Too often he would listen attentively, then shake his head ruefully, saying, "If you say so, it must be true; but I don't remember a bit of it." In such cases no therapeutic benefit was obtained.

Our next attempt was to induce the state of chemical hypnosis; get the patient to recite the events of the amnesia; then, by simulating battle noises, the shouts of his comrades and all the dramatic situation, have him relive the episode subjectively in its entirety. This abreaction technic produced more good results, but too many patients continued to fail to recall the amnesic events after full return to consciousness.

The next attempt was to have a corpsman stay with the patient for two or three hours after the treatment, keeping him awake and going over and over the amnesic material. This technic was abandoned because of the lack of an adequate resourceful personnel and because the patient was often so noisy and active during the period that he kept the entire ward in an upset state and required the assistance of more corpsmen than were available to restrain him. It was feared, also, that patients might injure themselves or the corpsman in attendance during these

periods. Because of these practical considerations this technic was abandoned.

Our next innovation proved to be a successful one. We decided that if the patient could be wakened immediately after recovering his amnesia he might be able to integrate it into consciousness. We turned to the analeptic drugs for this purpose. Those we had available were nikethamide [24a] and metrazol. The rapid injection of 10 cc. of nikethamide or 5 cc. of metrazol wakened these patients immediately, and a quick review of the amnesic events then led almost invariably to complete integration of the amnesia into consciousness. Of the two analeptic drugs nikethamide proved to be the better, and it came to be adopted routinely.

THERAPEUTIC PROCEDURE ULTIMATELY ADOPTED

The technic of chemical hypnosis—or narcotic hypnosis, or narcohypnosis, or narcoanalysis, or narcosynthesis, or chemical abreaction, or ventilation, to list its many synonyms—is a lengthy procedure in cases of blast injury. Although we were pressed for time, we found that one to two hours was required to do the work correctly. In a small number of cases we were required to repeat the procedure a second or a third time, but the number of successes after a single treatment rose as our skill increased. The technic has been described by others in the treatment of various psychoneuroses. Because of the peculiar difficulties encountered in the use of this therapy in cases of blast injury, it is well to describe our variations in technic in detail.

Preparation of the Patient.—Premedication with 1/150 grain (0.4 mg.) of atropine is given hypodermically, and the patient is placed on a well built, padded table. The procedure is explained to him as an attempt to recover memory for the period of unconsciousness following the blast experience. The soldier is questioned about the events immediately preceding the blast. He is asked what he was doing at the time, the names of those near him, the tactical situation, and so on. He is also questioned about his situation and circumstances when consciousness returned fully, so that an exact end point of the amnesia is known.

Induction.—A 2 per cent solution of sodium pentothal in a 30 or 50 cc. syringe is then injected in an arm vein while the soldier counts backward from 100. The rate of injection varies as it does in surgical anesthesia, but in the usual case the patient begins to slow up or become confused in his counting after the injection of 10 to 15 cc. The injection is continued until light sleep is induced. The patient is permitted to sleep a minute or two, and then, by shaking his head or slapping his face, he is awakened. This level of profound drowsiness on the brink of sleep is the proper one, and enough pentothal is injected from time to time to maintain this optimum partial sleep state.

Probing Technic.—The patient is quiet and relaxed. His speech is thick and ataxic. His eyes, if they remain open, do not converge. He is told that he is to talk about the blast experience. In actual words the conversation goes something like this:

24a. Commonly known as Coramine.

"Jones, wake up and talk to me. We are going to talk about that time your squad was moving across the field to take that little village outside Cologne; remember? It was a gray day, shortly after noon; you had just had your chow. The sun was trying to come out between the clouds. Sergeant Smith was in the lead; then came Brown, and you followed with a B.A.R.; remember?"

Any of a number of responses may take place. A goodly number of patients will pick up the story and carry on. Another soldier may tend to ramble, wanting to talk of his intense admiration, or his equally intense dislike, for Sergeant Smith. Another may want to talk about his fine comrade Brown and the wonderful time they had on a twenty-four hour pass together in Liege. Another may want to describe the terrain and the tactical situation with the thoroughness of a Douglas Southall Freeman. These excursions into other matters must be discouraged if they are not germane to the narrative, and the patient must be urged along the line of productive inquiry. He begins to talk, usually in the earthy idiom of the soldier. He tells of shells coming in, of flattening on the ground.

"What is the first thing you remember after that?" he is asked.

"I don't remember anything! I was out like a light until I came 'to' near an aid station," he may say.

In other cases, without further prodding, he may begin to unfold an orderly, chronologic, well worded recapitulation of the entire period of amnesia. There are no two cases alike, and one cannot predict beforehand the amount of difficulty which may be encountered. In this regard the procedure is the same sort of an adventure as a laparotomy: the surgeon never knows quite how much difficulty he is going to encounter when he opens the peritoneum.

If the patient does not begin to recall the amnesia, a technic something like this is followed:

"No, you were not really 'out'; you were just stunned. You can see it all now. Everything is clearer to you. What is the first thing you remember after the shell went off? Where was Sergeant Smith? What happened to Brown? Think! Tell me!"

Sometimes easily, sometimes after great difficulty, a surprised exclamation follows, and the verbal picture begins to unfold:

"Oh yeah! Now I remember. Brown was hit. He was yelling for the medics. He was yelling for me, too. I tried to crawl, but my legs wouldn't work. My goddam legs! I was paralyzed! My head was splitting, and I couldn't hardly hear. I was shaking like a leaf. Christ, it was awful."

He is urged to continue with the story, which may reveal that Sergeant Smith crawled back to Brown, then herded both men into a ditch to avoid further injury; that Brown had an arm wound; that Sergeant Smith bandaged his wound and gave him some sulfonamide pills, while he, Jones, lay there shivering and shaking, feeling that his head would burst. Then the story may go on to tell how more shells came in, how they all prayed, how he was unable to hold the cigaret he was given, how he became frantic with the continued shelling, how he tried to get out of the ditch, how the others had to sit on him until the shelling slackened, how the "medic" came up and how he walked and stumbled between Brown and the "medic" to the rear, where they were put on a jeep and how he finally regained consciousness as they were riding to the aid station.

The tale is often more complex and more harrowing than that just related. It is advisable to have three or four corpsmen standing by during this recital, because the patient may try to leap off the table. At any point there may be a block in the narration, and it may become necessary to ask many questions in order to

get beyond an episode for which there may be a more profound amnesia. By constant insistence and reiteration, the memory is recovered for the entire period, step by step.

Review.—We have found it profitable at this point to recapitulate the entire narrative for the patient. Notes kept during the period of probing are consulted if necessary. The soldier is told:

"Now you have told me everything that happened to you after you were blown up by that shell. I am going to tell it back to you, and I want you to interrupt me and correct me on any point that may be wrong."

The story is then reviewed for the patient, and in this way it is checked accurately and enriched in detail. At the end of this review, the needle is withdrawn, and the patient is told to go to sleep.

Abreaction.—The corpsmen now range themselves strategically around the table, holding the patient in light restraint. He is told rather excitedly, "You're back up there now, you and Brown and Sergeant Smith and the rest of the squad. You're starting across the field. The 88's are coming in! Hear them? Hit the dirt!" At that point the sound of 88 mm. shells is simulated. The patient becomes extremely agitated and tries to leave the table. A corpsman plays the role of Brown, begins to cry that he is hit, begins to call for Jones, the "medics." Another plays the part of Sergeant Smith, orders the patient into a ditch. The patient is then seized with a violent shaking. In this manner the whole amnesia is quickly reviewed scene by scene, with the patient reliving the entire experience subjectively and with dramatic intensity. By employing appropriate sounds and words, the patient is quickly changed from a quiet, objective story teller to a frightened, desperate soldier, reliving the episode with the hard reality of the original experience. At the end of this abreaction, as it has been called, the patient is often exhausted.

Waking.—Another venipuncture is done quickly, and the sound of shells is mimicked once more. Simultaneously, as the soldier struggles to get away from the shells, 10 cc. of nikethamide is injected quickly. Within about a minute his face begins to flush, he sits up, and in about 80 per cent of cases he begins to sneeze violently. The sneezing lasts thirty to sixty seconds, and then the patient looks around, often scratches the skin of his chest and shoulders, rubs his eyes and head, recognizes his surroundings and is fully awake.

Recapitulation.—The soldier is told that while he was asleep he related his entire amnesic experience, and now that he is awake he will be able to recall everything. With very little prodding, and a suggestion here and there, he unfolds the whole episode again, often more rationally and in more detail than when under the drug. Many patients are amazed at the vividness of their recall as the narrative races on. When he has finished his recital, he is led back to his bed by one of the corpsmen who has been present throughout the procedure, and they talk over the experience as soldier to soldier, usually with much smoking of cigarets. Later in the day the patient is instructed to write out the entire episode on paper. He is encouraged to make it as lengthy and as detailed as he chooses. By his committing the experience to writing, its conscious recall is strengthened.

After-Care.—Many patients do not sleep well on the night after treatment. On the next morning or on the second morning most patients report great improvement in symptoms. They speak of relief of headache; they appear more buoyant, and the anxious facies has changed to a more placid one. They often use this phrase, "My head is clear now," instead of saying that the headache has abated.

This has been told to us so often that we suspect that the complaint originally was an intellectual and emotional torpor rather than a true pain in the head and that the generic word "headache" was used to describe it because of limitations of vocabulary.

The events of the amnesia are then discussed with the patient. About 1 in 4 has an adverse emotional reaction to the material uncovered. The noncommissioned officer often has a guilt reaction to the situation: He has failed in his duty to his squad. The soldier who struck his good friend during a panic reaction is deeply chagrined. The sensitive man who shot a sniper who turned out to be a woman may be so upset that he is advised to discuss this breach of ethics with the chaplain. The rifleman who has been tormented with distorted dreams is made to understand that they stem from a real situation which occurred after his blast. The occasional soldier who had the delusion that he was captured by the enemy, and tried to shoot his comrades and run away from them, is deeply shocked to realize that such a paranoid distortion of the thinking process could occur in him. The patient who has to live with the memory that his buddy who was in a hole with him was decapitated by the same shell that made him unconscious is in need of help. A desperate domestic situation which is interwoven with the deep anxiety following blast, and which reveals itself during the treatment session, must be discussed fully. Grinker and Spiegel [22b] have called this process narcosynthesis. In some cases a series of interviews is necessary to bring the patient to adopt a healthy mature attitude toward such emotion-laden material, but this is not the rule. Most combat soldiers are realists, and they have learned to handle psychic trauma. Sympathetic handling, an attitude of naked frankness and the insistence that this is one more thing he will have to learn to live with in order to preserve his emotional health usually suffice.

The individual nature of this therapy has precluded the use of any kind of group psychotherapy with these patients. A subtle but effective group psychotherapy is constantly at work, however. These patients are kept in a ward together. The newly treated patient gravitates toward others who have been treated in a similar fashion, and the dilution of his experience with that of the group has a salutary effect.

Adjunctive Therapies.—An appreciable number of these patients are deteriorated physically and have a more or less chronic gastrointestinal dysfunction. Such patients are then given a period of modified insulin therapy (Sargant) in other wards until they have regained normal weight and digestive habits. Others with mild depressive reactions are given amphetamine for a variable number of days. Those not requiring such therapy, or any other medical or surgical attention, are moved to the rehabilitation section as soon as it is evident that they have improved. This may be done as early as forty-eight hours after treatment. There they receive a two weeks program of physical and military training and then appear before the disposition section.

EVALUATION OF THERAPEUTIC PROCEDURE

How true are these narratives which unfold themselves under chemical hypnosis? It is not possible to answer this question accurately. We have had occasion to check the stories of 3 out of 80 of the patients. Other patients in the hospital who were in the same squad and were evacuated with the blast casualties have checked over the patient's

narrative with us. In each instance they have corroborated his statements. This may not prove to be the case universally, but it is our opinion that it makes little difference. Whether something occurred this way or that way is not so important as the patient's belief in its reality. For example, a frequent distortion of belief on the part of the combat soldier is that a wounded comrade is dead, and in that instance it is the belief rather than the fact which has emotional and intellectual importance for him. We have accepted this solipsismal approach pragmatically, and we do not haggle over the question of the veracity of experiences told us under pentothal narcosis.

The company grade officer and the noncommissioned officer of the line know far more about the acute manifestations of the blast syndrome than any one else. Their descriptions of the behavior of blasted soldiers give support to the notion that what we hear and see relived under chemical hypnosis is close to the original experience in most cases. It is seldom that a man is rendered comatose by nearby shell blast. In any event, it is an unusual kind of coma when it does occur. It is treated by shaking, prodding or even kicking the soldier, after which he wakens suddenly. They tell us that at that point the patient may become acutely "wild" and attempt to run away or attack his friends. Much more often the blasted soldier hits the ground, begins to shake violently and even yells or cries. Often he crawls, unable to walk. A few assume catatonic postures. Another few go immediately into panic behavior. In the usual case other soldiers get hold of the casualty, get him to cover and continue to shake and slap him. At this point a cigaret is usually introduced. While he attempts to smoke, they talk to him and try to "bring him around." If he has not regained his composure in the time it takes to smoke a cigaret (five minutes), he is usually evacuated to the rear. One group of platoon leaders in an infantry division of large experience estimated for us that less than 5 per cent are comatose initially, about 5 per cent are in acute panic initially, less than 5 per cent "freeze" in catatonic attitudes and the remainder shake violently, with varying degrees of crying, shouting or jargon speech. From that point just about any form of dissociative behavior may occur until consciousness returns. This is consistent with the stories we hear under chemical hypnosis, and therefore we have come to believe that, in general, the patient is describing and reliving actual experience under the drug in cases of blast injury.

In occasional cases the conscious recall of the amnesic material is pathologically vivid and remains so for some days. The soldier can think of nothing else, can talk of nothing else and is unable to divert himself from it. When this is present, headache and anxiety persist, and sleep is poor. The longest time we have seen this condition last is five days, and then the episode began to lose its pervading intensity

and the patient's symptoms abated. One soldier described this state as follows:

"It's like I am in a theater and this picture is being shown over and over on the screen. I try to get away from it, but everywhere I go the picture goes with me."

Another patient wrote out his subjective reaction to this phenomenon. He said that is was stamped in his mind, that it prevented him from reading, writing or going to entertainments and even distracted him while eating, thus robbing him of appetite. He met a soldier from his home town, an old friend who was a member of the hospital detachment. He could not talk of the pleasant gossip of home with this friend but felt impelled to describe the amnesic material over and over, although his friend urged him to get the thing off his mind. We have found that it is best to wait for such abnormally vivid recall to abate naturally, rather than to try to interfere with psychotherapeutic or chemotherapeutic measures, since it always does so of its own accord within a matter of days.

There is no direct correlation between the length of time elapsed between blast and treatment and the ease with which memory is recalled. We got the impression that certain advantages were derived from early treatment, but that this was not consistently the case. When the patient is seen and treated early, he is able to recall the events before and after blast more clearly, thus facilitating treatment. Symptoms existing for long periods become deeply rooted and change the soldier's outlook and habits. The factor of secondary gain from neurotic symptoms is larger in chronic cases on the whole. On the other hand, we have seen striking relief of symptoms in cases of long duration, so that no rigid rule seems to apply. The lesson to be learned from this observation is that it is worth while to attempt treatment however long symptoms have persisted. One of our most gratifying results occurred in a soldier who had blast injury at Anzio in February 1944 and who was treated in May 1945.

Because so few patients had evidence of intracranial bleeding, and because they seemed to have the same symptoms as the rest of the patients with blast injury, chemical hypnosis was carried out on them exactly as it was in the entire group. In each of the 2 patients with hemorrhage a good therapeutic result occurred, and these patients were discharged to duty. The manner of response of these patients to therapy led us to the conclusion that bleeding into the central nervous system was not of primary importance but was a secondary matter—that the bleeding which occurred was not a phenomenon of etiologic importance but that it was an epiphenomenon in the course of blast injury.

It is probable that verbal hypnosis can be substituted for chemical hypnosis as a therapeutic technic in selected cases of blast injury. We are indebted to Capt. Oscar Legault, M.C., for preliminary observations on this method. In 2 cases he was successful in recovering and resynthesizing postblast amnesic material, and in 2 cases he reported failure with the use of classic hypnotic technic. He deliberately chose cases which appeared difficult, and it is probable that in a larger series the technic would prove more effective.

During our therapeutic investigations, we varied the technic occasionally for purposes of study. In some cases we avoided the review of the amnesic material while the patient was under pentothal hypnosis; in others we avoided the immediate recapitulation after recovery of consciousness. In some instances the patient was not required to write out the amnesic material. In another group the abreaction phase of therapy was deliberately omitted. We found that we were able to achieve successful results with all these variations, including the avoidance of abreaction. Any variation, however, which produced an inadequate recovery of memory for the amnesic material left the patient without therapeutic benefit. From these observations, we concluded that the least common denominator of therapy, the *sine qua non* of therapeutic effectiveness, was the recovery and emotional resynthesis of memory for the amnesic material. As long as that remains the therapeutic aim, wide latitude in devices to bring it about seems permissible.

A last point worthy of comment is the question of the recovery of memory for the sound of the explosion. It will be remembered that the patient has a retrograde amnesia of short duration and that the one thing he consistently fails to remember is the sound of the explosion itself. This is never recalled when he is under the drug either, even after direct accurate questioning. It is possible to suggest that the patient heard the explosion, but if this is not done he will maintain his original opinion that he did not hear it. One is driven to the conclusion that this sound never registers itself in consciousness in these patients.

THERAPEUTIC RESULTS

There is one symptom which is never entirely alleviated by any of the technics of chemical hypnosis we have employed—the complaint of sensitivity to noise. The auditory mechanism remains pathologically alert in these patients, and loud noise is capable of producing transient headache in almost all cases. At the time most of them leave the hospital, two or three weeks after treatment, this complaint is much less acute but is seldom completely obliterated. We were forced to excuse these patients from practice on the rifle range at the rehabilitation camp

because so many of them complained of the effect of the noise of gunfire. Some who volunteered to go to the range found that it caused a recrudescence of headache which they had not expected to occur. As a consequence of this sensitivity to noise, we have not sent these patients to combat duty because we felt that the noise of battle would be intolerable to them. With the exception of 2 patients who insisted on returning to combat after assuring us that they were no longer sensitive to noise, we have placed all others going to duty on limited noncombat status in the European Theater.

With the ether technic, about half the patients experienced therapeutic benefit from the recovery of amnesia, and these patients were sent to duty. Two were evacuated to the Zone of the Interior. One was mentally deficient, and the other appeared to have petit mal seizures which antedated the blast. Those who did not respond were treated with sodium pentothal (table).

Therapeutic Results of Chemical Hypnosis in Patients with Blast Injury

	Technic		
	Ether	Pentothal	Pentothal-Nikethamide
Patients treated	21	15	58
Therapeutic successes	10	10	53
Patients returned to duty	10	10	53
Patients retained for further treatment	9	5	..
Patients evacuated to Zone of Interior	2	..	2
Patients held in hospital	..	..	3

With the pentothal technic, two thirds of a small series were able to recover from their amnesia and were sent to duty. The remainder were treated with pentothal and nikethamide (table).

The majority of the patients were finally treated with the pentothal-nikethamide method. Of 58 patients so treated, 53 returned to duty. Two patients were evacuated to the Zone of the Interior as therapeutic failures. Both were patients who had complained of headache for many years prior to blast injury, and both gave histories of chronic psychoneurotic behavior. Three more patients were retained in hospital, complaining of chronic headache, sensitivity to noise and vertigo. It appeared that they would not be returned to duty and would have to be evacuated as well (table).

No follow-up studies are available on the patients treated. They went from hospital to reenforcement depots and from there to limited assignment duties. None have returned here, but it is not certain that they were not rehospitalized elsewhere after discharge. The assignment of these patients to duty was the decision of Major Morris Kleinerman, M.C., Chief of the Disposition Section. He was asked to make a short

comment on each patient at the time of discharge. He found that many were still somewhat sensitive to noise, that some complained of occasional headache and that others were somewhat tense and anxious at the time of discharge; but in no case were these complaints regarded as incapacitating, and it was felt that the patients would continue to maintain their therapeutic improvement.

SUSCEPTIBILITY TO BLAST INJURY

Not all soldiers appear to be equally susceptible to the damaging effects of nearby explosions. Two soldiers may be side by side, and a shell may explode directly in front of them. One may exhibit the blast injury syndrome; the other may go right on without any untoward effects. This has often been explained by the capricious manner and direction of spread of the blast wave, and this consideration cannot be underestimated. On the other hand, the nervous system of the recipient of the blast wave must not be ignored. To explain this is not easy, and we can offer no conclusive data. To say that all soldiers who become blast victims are chronically neurotic and emotionally unstable does not fit the facts. Longitudinal histories and previous battle performances of our patients do not bear this out. Most of the patients are well integrated persons. Approximately 10 per cent of the series gave a history of previous neurotic instability, and these soldiers appeared to experience blast injury relatively early in their combat career. In the larger group fatigue appears to play a role. Line officers report that when a man has gone for days without proper sleep or food he is more susceptible to blast injury than when he is fresh and properly nourished. In others the blast syndrome seems never to develop.

One officer of the line estimated that if ten soldiers were placed in a circle in an open field and a shell were exploded in their center, one or two would suffer blast injury and the others would escape. Barrow and Rhoads [25] reported an occurrence similar to this. Two hundred persons were standing together when a large blast occurred. Less than 20 per cent had periods of unconsciousness as a result. We have no data on this subject; but, if we accept the impressions of observers in combat, there seem to be persons who are obviously neurotic and predisposed to blast, those who are apparently stable but susceptible to blast, those whose susceptibility is increased by the fatigue of combat and its consequent tensions and those who are apparently immune to this disorder. Blast injury appears to be similar to sequelae of head injury in this regard.

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25. Barrow, D. W., and Rhoads, H. T.: Blast Concussion Injury, J. A. M. A. **125**:900 (July 29) 1944.

RELATION OF BLAST INJURY TO POST-TRAUMATIC COMPLAINTS OF HEAD INJURY

Throughout this inquiry the relation between the blast syndrome and the syndrome of the chronic post-traumatic complaints of patients who have received a direct injury to the head has been considered. A small number of patients reported that they were struck on the head by bricks or rubble at the time of the blast, and for these patients the therapy appeared as efficacious as for the much larger number who had escaped a direct blow to the head. One case in particular brought the problem into clear relief.

A rifleman aged 29 had suffered a blast injury near Mortain, France, on Aug. 12, 1944. This was followed by amnesia of twenty minutes' duration and the usual sequelae. He was evacuated to a hospital in England. On September 10, he was sitting on the hospital lawn reading a book, when he was struck on the left side of the head by a croquet ball driven by another patient. He was rendered unconscious by the blow and came to his senses about a half-hour later, while roentgenograms of his head were being made. After the second traumatic episode his symptoms were aggravated. He complained of constant dull frontal headache, vertigo of floating type, sensitivity to noise, jitteriness, insomnia and inability to concentrate. He remained in the hospital until December 1944 and was then assigned to a reenforcement depot. He remained in the replacement system for the next three months, moving from depot to depot, and continued to voice his complaints, for which he was finally rehospitalized.

On March 22, 1945 he was treated by chemical hypnosis with the pentothal nikethamide technic. It was possible to recover the amnesic material for both the blast experience and the blow to the head. Under pentothal hypnosis he was able to tell of being blown halfway out of a foxhole by the blast. He lay on his face, shaking violently. Then he heard the soldier in the next foxhole calling for the "medics." He crawled into the wounded man's hole, found him to have an abdominal wound and, as soon as he was able crawled and staggered to the rear. He rested in a clump of trees for a moment, then found his way to a road. There he met a major, who wanted to know what he was doing. The major ordered him to proceed down the road to the nearest aid station. Along the way he met an ambulance and told its occupants about his wounded comrade. He came to consciousness shortly thereafter, as he was walking toward the aid station.

He was then asked to describe the second episode. He said that the blow from the croquet ball knocked him to the ground and that the soldier who drove the ball ran to him and tried to apologize. The ward nurse ran out of the door, upbraided the offender and called for a corpsman to help her. The patient was lifted by the soldier and assisted to the ward, walking between the nurse and the corpsman. He was placed on his bed and the ward officer was called. The latter examined the patient, filled out a requisition for roentgenograms of the skull and told the ward man to take the patient to the department of roentgenology. He was lifted on to a wheel litter and was rolled about 200 yards (180 meters) along walkways to the roentgenology building and placed on a table. He woke up while pictures were being taken. The patient reported amelioration of all his symptoms after this amnesic material was recovered in consciousness, and he was returned to duty.

Another soldier, who had received a blow to the side of the head from the knee of a base runner during a game of baseball at Fort Meade, Md., nine months previously, was treated in a similar way. Under chemical hypnosis he was able to picture all the details of being carried off the field to the dispensary and of waking while a small supraorbital laceration was being treated. He made a good recovery and was deliberately kept in the rehabilitation section for sixty days, where he worked as a cook, so that his progress might be followed. During that time he did not complain of headache or vertigo. These symptoms had been so persistent prior to treatment that he had become a chronic visitor on sick call and had been rehospitalized on two occasions for study.

Another patient with head injury, an infantry man aged 23, was riding in a jeep east of Paris in August 1944 under blackout conditions on a dark night. The next thing he knew was that he was in a hospital, with his head bandaged. He had a large laceration of the left side of his forehead, and he surmised that the vehicle had been shelled. He was left with chronic persistent bitemporal headache, vertigo and insomnia. He was kept in hospital for ninety days and was then placed on limited duty as a welder in an ordnance unit. He was happy in this work, because welding had been his premilitary occupation. His headache failed to improve, however, and he was rehospitalized. By means of chemical hypnosis, it was found that his vehicle was not shelled but that it had a head-on collision with another jeep in the blackout. The vehicle turned over, and the patient was pinned underneath. The other soldiers lifted the jeep and dragged him out from under it. They carried him to the shoulder of the road, and 2 medical soldiers from the other vehicle bandaged his head. An ambulance was called by radio (the radio in the jeep was still in operation after the accident), and it came along about twenty minutes later. He was removed to the hospital and returned to consciousness shortly thereafter. After the recovery of this amnesic material in consciousness he had complete cessation of headache and other symptoms and was returned to his unit.

Our experience with treating post-traumatic complaints of head injury by chemical hypnosis with the pentothal nikethamide technic is limited to a small number of cases at this time. Capt. David Turnoff, M.C., has had therapeutic success in another small number of cases with this method. There have been a number of failures as well. It is our opinion that the failures occur especially in those cases in which there are painful scars in the scalp, bony defects in the skull, evidence of widespread cerebral damage, and the like. More work will be necessary to confirm these observations, but preliminary studies suggest that this technic may develop into a useful therapeutic tool in the large problem of treatment of the chronic sequelae to head injury of headache, vertigo and symptoms of tension.

SUMMARY

A study of 80 consecutive cases of blast injury in combat soldiers was carried out. It was found that the disorder occurs among men of all ranks, in new troops as well as in veterans of combat. All types of explosive agents can cause the disorder. Some soldiers become blast victims after a single nearby explosion; others succumb as the result

of the cumulative effect of a barrage. The unconsciousness produced by blast is characterized by a retrograde amnesia for the sound of the explosion and by a period of anterograde unconsciousness of variable length, but lasting an hour in the usual case. The unconsciousness is seldom characterized by coma, but, rather is marked by dissociated, aimless behavior. On return of consciousness, the patient complains of protracted headache which is nonspecific in position and quality and which may be constant or intermittent. In addition, he complains of tinnitus, which is usually nonpersistent, and of diffuse anxiety symptoms. About one-half the patients complain of a generalized somatic soreness for a day or two after blast injury. They show no evidence of focal damage to the central nervous system on neurologic examination, and few have bleeding from any of the orifices. Study of the spinal fluid shows normal pressure and normal cellular and protein contents. Bleeding into the fluid is extremely rare (2.5 per cent).

A successful method of therapy was discovered during an inquiry into the nature of the unconsciousness of these patients. It was found that memory for the unconscious period could be recalled under chemical hypnosis and it was therefore an amnesia of the type seen in hysteria. Furthermore, it was noted that there was dramatic relief of symptoms in cases in which there was good conscious recall for the amnesic material.

Clinical experimentation with the technic of chemical hypnosis led to a modification which proved successful in bringing about recovery of postblast amnesic material. The method employs intravenous injection of sodium pentothal to produce chemical hypnosis and exploration of the amnesic material, followed by rapid wakening with intravenous injection of nikethamide. The technic is described in detail. It proved of therapeutic value in more than 90 per cent of patients.

The problem of individual susceptibility to blast injury is raised. The relation between blast injury and head injury is pointed out, and it is demonstrated that the pentothal-nikethamide technic can be employed successfully in some cases of the chronic sequelae of head injury, as well as in cases of blast injury.

REPORT OF CASES

The following cases are illustrative of various aspects of blast injury. Proper names have been altered throughout; otherwise no changes have been made in factual data.

The first case is a typical one and is described in detail. An attempt has been made to put down the actual dialogue employed during treatment, although we were unable to record it verbatim.

CASE 1.—V. P., technical sergeant in a rifle platoon, aged 24, entered the hospital May 4, 1945, complaining of headache, "jitters" and lack of "pep." The patient had been in combat for four months, when he was "knocked out" for two hours by the effect of shell blast, on March 13, 1945. He returned to

consciousness while walking down a street in the company of one of his squad sergeants. He had severe pounding frontal headache and tinnitus and felt "flighty" and excited. His hands were trembling, and every muscle in his body felt as though it had been mashed. He was kept in the divisional area for two weeks and then went back to duty on his own insistence, even though his headache and tremulousness had not abated. He found that he fatigued easily and that the noise of artillery, friendly or enemy, was almost unendurable because it caused his head to hurt violently and produced increased tremor. After three days in the line he was evacuated.

He spent one month in other hospitals. He was given rest and symptomatic treatment, but his headache and tremulousness continued. His chief concern was his anxiety reaction. He spoke of it as something he had never experienced before and said that he was "getting mighty disgusted" with himself, "feeling so shaky inside all the time." His tinnitus was not entirely gone. He said that he experienced ringing in both ears for a few minutes several times a day. He was concerned about his abnormal sense of fatigue. He had left school in the fifth grade because he had to earn a living, and therefore he had never developed the habit of reading anything but newspapers. He complained now that he could not concentrate enough even to read a paragraph of the Army newspaper. He was not actually depressed and assured himself that he would "snap out of it," but he was apathetic and kept to himself.

Physical examination revealed nothing abnormal except for tremor of the outstretched hands. His blood pressure was 140 systolic and 80 diastolic and his pulse rate 112. Neurologic examination elicited nothing of significance. Lumbar puncture released an entirely normal fluid, under 160 mm. of pressure.

On May 10, 1945, after premedication with atropine, light sleep was induced with intravenous injection of 18 cc. of 2 per cent pentothal sodium. He was wakened by slapping his face and was asked to begin to talk about his blast experience. He was reminded that it had occurred late in the afternoon on a sunny day, when his platoon was attempting to take a hill beyond a sanatorium near Remagen, Germany. He rubbed his forehead and began to talk.

"Yes, that was a hot spot. There was a lot of shelling. Mortars and 88's all mixed up. There must have been a half million of them. They were killing my men. I was waiting for orders to move on or do something. There was a lot of shallow trenches on that hill—I guess the Jerries dug them. They were no damn good—too shallow. I yelled to the men to take the best cover they could, to flatten out in those damn shallow trenches. I crawled along from trench to trench, seeing how the men were, and I snuggled into a hole then myself. That was a hot spot, that hill!" At that, the patient removed his hand from his forehead and lay limp on the table. No more speech came from him.

"What happened next, Sergeant? What did you do then? What went on when you were in that hole?"

There was a pause, and the patient seemed to be asleep. He was slapped slightly on the face and was asked the same questions; at the same time he was exhorted to think and was assured that it was clearer now, that he could remember better.

He began. "One of those things must have hit almost in my hip pocket. I was dizzy. I moved to the next hole. I was dizzy. Then I heard Sergeant Wise yelling over to me, 'What happened to you?' I heard him calling over, calling out my name, but I couldn't answer. Then after a bit he came over and said, 'Sergeant, what's wrong?' and I could answer him then. I said, 'Nothing, I'm good as new.' I tried to get out of the hole, but I couldn't. He had to help

me. You know, that's a funny thing. I was weak as a kitten." At that the patient stopped talking and shook his head, apparently ruminating over his profound weakness at that moment.

"What happened next, after Sergeant Wise helped you out of that hole?"

After a short pause he replied, "He told me about Lieutenant Anders."

"What about Lieutenant Anders?" he was asked.

"Sergeant Wise told me that he was wounded in the leg," he said.

"What then?" I asked.

"I didn't know what to say to that. We all liked Lieutenant Anders. So I got up and . . ." At this point the patient laughed. "And do you know what I did? I walked smack into a tree. I don't know why, for I could see the tree, but I guess I didn't have much sense then. . . . And, do you know, I got mad at that tree. I hit it with my fist. Isn't that the silliest damned thing?"

"What happened next, Sergeant?"

"Well, Sergeant Buck came along about then and asked me what was wrong, and I said nothing was. He said, 'You'll have to come with me,' and I said, 'Where do you mean?' and he said, 'Just come with me'; so he took me by one side and the platoon runner got me by the other side, and they began to walk me down the hill, the same way as we came up, along a path. My head felt like hell, and I was dizzy and my ears were ringing, but I didn't want them to hold me; so I shook them off me and said I'd walk by myself." There was a pause.

"And then what happened while you were going down the hill?" he was asked.

"Four of my boys were dead along that path. I looked at them. I got a lump in my throat. The clothes of one of them were still smoking. I had to step right over one of them to get down the path."

"Yes?"

"And then they began throwing 88's in. They were coming in fast, right on the path. I started to run, and I ran and ran. And then I heard Sergeant Buck behind me saying, 'Sergeant, you don't want to go that way,' and so I came back to Buck and the runner, and they held on to me, and we went down the path. We saw some men from another outfit digging in along the path. Buck said, 'Don't you guys take any chances. It's really rough up there," and then we got down on to a road."

"Yes?"

"We didn't know which way to go, but Buck said to go to the left; so we were going along this road when a bunch of rockets started coming in. Rockets make the damnedest noise! The other two hit the ditch alongside the road, but I didn't seem to be able to use my sense; so I just looked at them. Buck jumped out of the ditch and snatched me down. I told him not to throw me around that way. He told me he was doing it for my own good, and he said, 'Goddamit, why don't you snap out of it?' I guess he was pretty mad at me acting like that." There was a pause.

"What happened next, Sergeant, after the rockets went over?" I asked.

"Well, we got up, and a fellow came along in a jeep. Buck asked him where the aid station was, and he said he didn't know. I said, 'You look to me like a guy who doesn't know a goddam thing.' and I wanted to smack him, but Buck wouldn't let me.

"Yes?"

"Well, we walked along the road, and Buck made me hug a stone wall—wouldn't let me walk out in the middle of the road."

"What happened then?"

"Well, we walked along this wall, and we heard a lot of artillery going over. It made me sick, and I threw up. Then we came to a house and we went inside."

"What did you do in the house?"

"Well, there was a blonde standing near the door—pretty good-looking babe—but I didn't pay any attention to her. She sort of stood in our way; so I took my gloves that I had in my hand and slapped her across the backside and told her to get moving." At this the patient laughed.

"And then what, Sergeant?"

"Buck led me into another room and told me to lie down on a bed. It was a fine, soft bed with sheets and everything. Boy! That bed felt fine! He told me to rest there while he hunted up the aid station." There was a pause.

"What did you do then, Sergeant?"

"I must have dozed off to sleep, because the next thing I knew some one was shaking me by the shoulders and it was Buck, and he told me to get up and get going, because he had found the aid station. So I got up and walked out of the house with him, and as we were going up the street toward the station I came to my senses."

"How did you feel?"

"I felt like hell. My head hurt, my ears were ringing, and I felt shaky all over. I asked Buck what it was all about, and he told me that a shell had knocked me groggy, and we kept on up the street to the aid station—it wasn't far—and he turned me in to the medics."

Then he was told: "Now you have told me just what happened after the shell hit near you, and I'm going to tell it back to you, and you correct me if I'm wrong." This was followed by a relatively rapid retelling of the foregoing events. When the episode of the tree was described, he said, "Can you imagine that! Trying to knock a tree down with my fist!" When the episode of seeing the four dead men was described, he turned his head into the pillow and said, "Awful!" When I mentioned the episode of his wanting to strike the jeep driver because he didn't know the whereabouts of the aid station, he said, "Yes, that's right. I wanted to hit that guy. That poor devil probably didn't know what to make of me. I remember the surprised look on his face." When the episode of finding the German girl in the doorway was described, he interrupted to say, "Can't fraternize with them, can't fraternize! I won't let any of my men fool with the Jerries. And I don't, either. So I smacked her—didn't hit her hard; it was sort of playful like—and told her to get moving."

At the end of the verbal review the patient was told to go to sleep. The needle was withdrawn. Twenty-seven cubic centimeters of pentothal sodium had been given. He assumed a relaxed position on the table, as though sleeping quietly. The corpsmen, two on each side of the table, placed their hands in readiness to restrain motions of the patient's extremities; and then in an excited, hoarse whisper he was told, "You're back up on the hill, Sergeant! Trenches are too shallow! Tell the men to find cover! Listen to the 88's!"

At that the corpsmen began to whistle, simulating the whine of oncoming shells. A tin can, filled with broken glass, was kicked vigorously to simulate the sounds of shell explosions. The patient tried to leave the table in one convulsive leap but was restrained. He began to bark out orders: "Mac, get down! Chris, hey, Chris, crawl to your left! They've spotted us! Down, all of you, down!" He continued to struggle, to attempt to crawl, to shout orders. The sound of shelling was continued. Then an excessively loud sound was made. A corpsman called, saying, "What happened to you? This is Wise; what's

wrong?" The patient lay limp on the table. Then he was grasped by the shoulders and lifted up. "How are you feeling, Sarge? What's wrong?" He replied, "Nothing, nothing; I'm all right, good as new."

"Did you hear about Lieutenant Anders?" he was asked.

"No, what happened?"

"He got it."

"Bad? Where? Where is he?" he asked wildly.

"No, they said it wasn't too bad. The medics got him, and he's gone back."

"That's a damned shame," he said; "they don't make guys like that very often. I hope he makes out all right."

There was a pause, and then he was told quickly, "Tree! What are you doing, bumping into the tree?"

The patient tried to swing his right fist but was restrained. "This is Buck, Sarge. You'll have to come with me," he was told firmly.

"Where? Where to, Buck? Where are we going?" he asked.

"Just come along with me, this way," was the reply, and he was grasped by both arms, in a simulated pulling fashion. "Come on, down the hill here."

"This is the way we came up, ain't it, Buck?" he asked.

In this fashion, the entire amnesic period was relived subjectively, scene by scene, with dialogue and sound effects created as the action proceeded. Corpsmen quickly develop an appropriate sense of theater for these abreactions and interject questions, answers and expletives to fit the occasion. Using these technics, the patient was made to relive the passing of the dead bodies, the final descent to the road, the shelling, the episode of the jeep, the entrance into the house, the stretching out on the soft, clean bed, the shaking awake and the walk to the aid station.

Nikethamide was then injected quickly into an arm vein; 10 cc. was given as rapidly as possible. Within thirty seconds the patient's face was noted to flush, and he began to rub his scalp and eyes. He sat up, coughed a few times and then began to sneeze violently. The sneezing continued for almost a minute. Then he looked around the room, recognized a corpsman, smiled and said, "Hi, fella."

He was asked whether he knew where he was and was asked to identify those in the room. Within a minute he did this accurately, and it became evident that he was fully conscious and properly oriented. He was then told that he had had a treatment, that he had been describing the events which occurred after his blast experience, and he was asked to recall them for us.

Some scratching of the scalp and chest went on, and then patient said, "I remember trying to knock a tree down with my fists."

"That's right," he was told, "and many other things as well. Start at the beginning, and tell us all about it."

"Well, we were up on this hill beyond the sanatorium," he began, and then he gave a detailed account of the entire amnesic episode. The story came out in full detail, and the patient stopped during his account now and then to reveal his amazement at the extent of his ability to "see all this now, just like it happened."

At the end of this recital he dressed himself and walked back into the ward with one of the corpsmen. He was told to go over the story once again with the corpsman. This was done, and then the patient was instructed to write the story out on paper later in the afternoon just as though he were writing a letter to some one describing the episode in detail. He was advised to write as many pages as were necessary to make a full account. Because in this particular

instance the patient had had minimal educational advantages and was not in the habit of committing himself on paper, the written review was short and superficial.

On the morning after treatment the patient reported that he had not slept well, that he had ruminated over the amnesic material long into the night. Despite this, he said that his headache was much better and that he felt less fatigued. He was particularly gratified to find that his uncomfortable feeling of inward tremulousness was much improved.

The content of amnesic material was reviewed, and care was taken to note the patient's reaction to it. He stated that he must have looked "very goofy" to those about him during his amnesia but that he wasn't really ashamed of himself because he had seen other men act just that way after shell blast, and that he was probably no different than anybody else. The episode of wanting to hit the tree with his fists provoked a measure of astonishment but served to reveal to him the extent of his behavior disorder. The recall of memory for seeing four of his men killed was painful, but he summed it up by saying that it was some more death he had to look at: He had seen it before in battle; it was never easy to contemplate, but a soldier had to become hardened to death or go completely to pieces. He blushed when he talked about the way he had slapped the German girl, but he saw the humor in it and laughed about it. He had no real feeling of guilt about abandoning his platoon, but he did have genuine regret about it. He was sorry that he was no longer with his unit, but he concluded that he had done as much as he could, that he had tried to stay there and do his part as long as possible. It was felt that this was a healthy emotional reaction to the amnesic material, and the patient was advised to spend the day as he saw fit.

On the next morning he reported that he had slept soundly, that his headache was gone and that he no longer had the "jitters." He volunteered that he was beginning to feel like his former self. He was kept in the ward for two more days. He reported that loud noises made him jump and caused a shooting pain to go through his head. This was true especially of noises such as slamming doors and the clanging of metal stove lids. He complained of the noise of the mess hall, saying that it upset his appetite. On one occasion the mess hall was so noisy that he made himself some sandwiches and took them outside to eat them. He said that his tinnitus was completely gone.

On the fourth day after treatment he was transferred to the rehabilitation camp. While he was there, he participated in all the activities except firing on the rifle range. He found this too noisy even when he was 500 yards (460 meters) away from it. He did not attend sick call during his two weeks' stay there, and he reported no headache or other complaints during the rehabilitation period. When he appeared before the disposition section, he stated that he felt entirely well except for his sensitiveness to noise and the transient headache caused by loud noises. The diagnosis was "psychoneurosis, mixed type, secondary to shell blast March 13, 1945, in Germany, line of duty *yes*," and he was sent to a reenforcement depot with recommendation for assignment to limited duty.

The following case is an uncomplicated one and may be regarded as typical of many of the cases of blast injury in this series. It illustrates the manner in which a normally articulate soldier puts his amnesic material in writing after treatment.

CASE 2.—W. E. F., private first class, rifleman, aged 20, was admitted to the hospital April 27, 1945, complaining of headache, nervousness and dizzy spells. The patient was in combat from June 12 to July 13, 1944, when he was evacuated

because of shrapnel wounds in his right leg. On Jan. 3, 1945 he returned to combat. On March 24 a shell hit near the patient as he was standing on the bank of the Rhine waiting to board a boat for the crossing. He stated that he saw a bright flash, was rendered unconscious for approximately two hours and came to his senses in a British command post. He was shaky and complained of sharp headache in the right parietal region and bilateral tinnitus. He was taken to an American battalion aid station and was ultimately sent to this hospital.

On admission, his complaints were those of intermittent and sharp headache in the right parietal area, sensitivity to noise, startle reaction, epigastric distress, insomnia and recurrent battle dreams. Sudden attacks of dizziness of the floating type, lasting approximately one minute, occurred repeatedly throughout the day. They seemed worse on sudden change of position of the head. His tinnitus abated spontaneously the second day after his blast injury. General physical and neurologic examinations revealed nothing of significance except for a large scar on the inner aspect of the right knee, the result of his earlier wound. Lumbar puncture released an entirely normal fluid, under 180 mm. of pressure.

On May 3, 1945 the patient was treated by chemical hypnosis. After premedication with atropine, 1/150 grain (0.4 mg.) given hypodermically, a 2 per cent solution of pentothal sodium was introduced intravenously. He fell into light sleep after the administration of 15 cc. Two minutes later he was slapped lightly on the face and was instructed to talk about the morning when he was knocked out by shell blast on the bank of the Rhine. With very little prodding, the story came out in a logical chronologic fashion. After he had told of the episode, it was reviewed for him. The needle was then withdrawn. Twenty-three cubic centimeters had been injected. The patient was told to go to sleep, and he closed his eyes and relaxed completely on the table.

Then he was told excitedly, "There comes the L. C. V. P. [boat] over the river to get us! See it?" Then followed a loud whistle and a banging sound made by a corpsman kicking a tin can full of broken glass. The patient tried to leap from the table. As more shells were simulated, he struggled to leave the table. In rapid succession he tried to jump into a foxhole and to run away. He was asked in a British voice, "Where are you going, Yank?" and he replied, "I dunno! Where am I?" He was then told to lie down, and he struggled, saying, "Let me go! I want to go back to the outfit!" He was told that he was too shaken up to return, that he had better get some rest. After some argument, he agreed and lay still. Then he was shaken by the shoulder and asked whether he wanted some breakfast. He replied in the affirmative and went through the motions of eating. Then he remarked, "What is this I'm drinking, tea? What a hell of a drink for breakfast! But that's what a guy gets for fooling around with you Limeys." He was told that he had better go to an aid station. He asked where it was. He was told, "Over there, that big building on the left." Then he mumbled his thanks for the breakfast.

At that point, 10 cc. of nikethamide was injected quickly into an arm vein. He flushed, coughed, rubbed his face and sat up. Then he sneezed repeatedly for one minute. At the end of that time he was fully awake and was able to recall all the events of his amnesia. He was returned to the ward, where he was told to repeat the content of his amnesia to a corpsman and then to write it out. His written account is as follows:

"Approximately at 11 p. m., March 23, we started for the Rhine, which resulted in an all-night hike, that is, until 3 a. m. We were put in buildings which were approximately two blocks from the Rhine, awaiting H hour.

"The order was received to move out immediately. We put our equipment on and started for the Rhine. The fellow behind me was lagging a little too far behind; so I hollered and told him to close it up. We arrived at the edge of the river and had to wait until the L. C. V. P. returned from the opposite shore. While we were waiting, Jerry was throwing some 240's [artillery]. Most of it went into town. All of a sudden I saw a large flash between the boat and me. Immediately I was lying in the prone position.

"After the explosions I got on my feet and started to run up the hill to a slit trench that I had noticed on the way to the River. While I was running up the hill, I heard a couple of the boys hollering for the medics. I reached the slit trench, and I lay there for awhile. The shells were still going over. Then one exploded fairly close to the slit trench, and it lifted me into the air. I took off and ran back to the town. I found a house that the English soldiers were using as an outpost. I went in the cellar, and the lieutenant made me lie down and sleep for awhile. It was still dark when this took place.

"The next thing I knew one of the fellows was shaking me to have breakfast. We had eggs, bacon, grape jam, bread, butter and tea. After I finished eating, I started to gather my equipment, and the sergeant (I believe) asked me where I was going, and I told him I was going to try and find my company. He suggested my going to the aid station. I went to the aid station and was evacuated from there to the evacuation hospital."

The patient slept well the first night after his treatment and did not dream. The next day he was much improved, saying that his headache was practically gone and that he had no dizziness. The amnesic material was reviewed, and the patient was pleasantly surprised at his ability to recall the material. He had no untoward emotional reaction to it. He concluded that he had acted like other soldiers he had seen after blast injury. He said, "I guess I just went goofy like a lot of other guys do when shells knock them out." He remained in the ward three more days, during which time he continued to be free from symptoms except that loud noises made him flinch and gave him a slight pain in the right side of his head. He was sent to the rehabilitation camp, where he spent two weeks and then was dismissed to limited assignment duty.

Case 3 is illustrative of the reaction of a somewhat obsessively conscientious soldier to blast injury. In this case the treatment session was abnormally long because the soldier insisted on giving a carefully detailed account of the amnesic material. It also illustrates how post-blast amnesic material can be emotionally traumatic when it is recovered in consciousness.

CASE 3.—E. P., private first class, a machine gunner, aged 24, was admitted to the hospital Feb. 10, 1945, because of laryngitis and headache. His laryngitis improved rapidly, but his headache persisted. He stated that the pain in his head began after a blast injury on Dec. 17, 1944, near Krinkelt, Germany, at the beginning of the Battle of the Belgian Bulge. He had been rendered unconscious for an hour or more by the blast, and this was followed by a constant dull occipital headache, extending into the parieties. Any loud noise caused a sharp, shooting pain throughout his head. In addition, he felt jittery, lost his appetite and complained of precordial heaviness, effort dyspnea and battle dreams. Despite these complaints, he continued in action until Jan. 27, 1945, in the counter offensive in the Ardennes. He was evacuated because of an acute infection of the upper

respiratory tract with fever and laryngitis. He was transferred from the ear, eye, nose and throat service when his laryngitis had subsided.

He stated that his unit, which had been in combat three months, had been on a forced march most of the night prior to his blast experience and that he was hungry, cold and extremely tired. He was wakened at daybreak the next morning, and shortly thereafter he was rendered unconscious by shell blast. It was his surmise that he was comatose for the next hour. When he recovered consciousness, he was sitting in an abandoned anti-aircraft-gun pit with some of his comrades. The Battle of the Ardennes continued at a heavy pace for several weeks after that, and he remained with his unit despite his complaints of headache, transient tinnitus and vertigo, loss of appetite, cardiorespiratory disorder and frequent dreams. He felt that if he kept going he would be able to "shake off" these complaints. It was his opinion, however, that he was about to turn himself in for medical aid because of his severe headache when the infection of the respiratory tract developed. So many casualties had occurred among older men that he felt obligated to remain on duty as long as possible to help the new reenforcements who were coming into the unit.

General physical and neurologic examinations revealed nothing abnormal. He was 12 pounds (5.4 Kg.) under his normal weight. He was quiet and cooperative but somewhat seclusive in his habits. He avoided all loud noises because they caused shooting pains in his head and had managed to move to a bed as far as possible from the ward radio. Lumbar puncture released clear fluid, which was under a pressure of 140 mm. and contained no red cells, 3 white cells per cubic millimeter and 34 mg. of protein per hundred cubic centimeters.

An attempt was made to treat him by chemical hypnosis, using ether by inhalation, but this was unsuccessful. A series of attempts to induce hypnosis by verbal means was equally ineffective. On March 24, 1945, chemical hypnosis was induced with intravenous injection of sodium pentothal. The patient went into light sleep after the injection of 18 cc. Two minutes later he was slapped on the face and told to describe his blast experience. He elected to begin his recital with an account of the long march which preceded the blast experience. All attempts to hasten him toward the blast experience and subsequent events were countered with, "Wait, wait; don't rush me. . . . I'll tell you all about it." Because he was a meticulous person, somewhat obsessive in his behavior, it was deemed best to let him tell the story in his own way. He described every change in contour of the terrain in greatest detail, named the type and age of every timber stand he walked through and gave a detailed account of every scrap of conversation he engaged in during the entire period. Slowly, carefully, accurately, the entire march, the final assuming of positions and the digging in were described. Then came a detailed account of dawn, the blast experience and his unit being cut to pieces by enemy artillery. The patient ministered to his wounded comrades and made repeated trips to the aid station with casualties. He had been amnesic for all this prior to treatment. Almost two hours were spent in the telling of these experiences. Then the material was reviewed quickly, and the needle was withdrawn. Thirty-eight cubic centimeters of pentothal sodium had been used. By employment of appropriate sounds and shouts the experience was reenacted in abreaction, but this was not unusually dramatic in this case. Then 10 cc. of nikethamide was injected intravenously. The patient sneezed once or twice, rubbed his eyes and was awake. He was able to give a full account of the amnesic material immediately. He spent the next two days writing out the experience.

Some of the preliminary material is omitted, but the following is the main body of his written account:

"The next couple of hours were not very eventful, as we marched along the edge of a wooded area opposite Krinkelt. There was a considerable amount of machine gun fire to our left. About an hour after darkness had settled, we met 395, where we learned that the message we had accepted was a phoney. So we turned back, retracing our same route. Artillery shells were constantly whizzing overhead. Krinkelt was in flames as we came around it. An ammo dump was hit, and flares flew in all directions and all colors, making our progress more difficult to keep from being observed. We finally got back to our old positions. We started to dig in, but we were so thick that we were moved up to the positions we had started to dig the previous morning on the hill. Instead of a section, our whole platoon took the hill.

"We were so all in and hungry that we didn't dig but used the shallow holes until daylight. I took the second watch that night. While on guard I saw a big burst up ahead of us. Nothing else followed; so no more thought was given it. Chris and I were holed up together; so he followed me on guard. I took a nap over a gas cape laid in the bottom of the hole to keep from getting more wet than we were.

"At the first indication of daylight we were all awakened by Parks.

"Chris left the hole, and I told him to hurry because we had a lot of digging to do. Right after he left, two shells came close, and I flattened out in the shallow hole. Then, ka-flooie! Everything went black. I just don't know how to describe a sensation of this type. The next thing I recall is crawling out of the debris piled over and around me. What a mess! What a sight! I found Ealing lying on his back. His left arm was off at the shoulder, but I wasn't quite aware of it at the moment. He was ghastly looking. I found a bloody canteen and washed and filled it in the stream. I raised his head enough for him to take his wound tablets. I covered him with blankets that I picked up. Shrapnel had torn the packs up so bad that the blankets were easily pulled from the pack.

"As I gathered up blankets, I came on Phillips being held in a sititing position by Nugent. I put a blanket around Phillips and lit up a smoke for him.

"McQuay lay nearby with the top of his head blown off. Damn unpleasant talking material. Nugent kept Phillips ignorant of McQuay's condition.

"I bumped into Tilney, and he mentioned Parks being up on the hill. Our aid man from the third platoon patched up the two big holes in Park's back. Poor devil was in helluva pain. I picked up a bayonet somewhere and cut a couple of poles for a litter. We gently put Parks on the litter and carried him to the aid station. I told the aid man to visit Ealing.

"I made a second trip to the hill. I learned that Stricker was somewhere up on the hill, too. We searched all over for him and spotted him in a crater. He was wounded in the leg and already had been patched up. There was a box ot morphine Syrettes lying near him. Tilney pocketed them. Windy was up there with us. We finally eased Strick on a litter that I managed to acquire from some bozo that had no use for it. We got our man to the aid station. I managed to stumble all over the creek. The other boys kept dry, but I got wetter than all get out. I saw Berry at the aid station. He told me he was all through with the war. Chris brought him in; I don't how or when. I sat against a tree to rest up. Felt too weak. I didn't think I could go any more. But I simply had to go up again. Went up again. Saw some fellows carrying somebody in on a litter. One of the carriers felt weak; so I gave them a lift. Damn, I had

to hold that handle with both hands. Got this fellow in okay, too. Sat down again, to rest up a bit.

"Met Jones at the aid station. We went up to gather what was left of our guns. There were three of us going up. Can't recall who the third fellow might be. He was just a short way ahead of us. We picked up all the junk we could carry. I also picked up a smashed rifle. Only one of the guns was any good, and that was for only about 500 rounds. We piled the junk on the road above the aid station.

"A case of rations was brought down. We devoured that in no time flat. We were all hungry, after not eating for so long. I got my back taped by an aid man after having a bite. Our troops were in changing mortar fire with the Jerry; so we hopped into an abandoned anti-aircraft-gun pit. There was a helluva lot of gunfire and machine gun fire to our left and front.

"From here on the trend of things I can easily recall. So I don't think it's necessary to write it down. It was all more or less being shelled."

The recall of this material was extremely painful to the patient. The sudden catastrophic loss of these friends despite his every effort to assist them was hard to contemplate. Another episode was so painful that he failed to write it down. His closest friend was killed that morning. As he was walking up the hill for the last time to salvage what material he could with Jones and the other man, they met a litter squad coming down. The face of the casualty was covered with blankets. The patient asked, "Who've you got there?" The reply was, "Downs. . . . Do you want to see him?" The patient answered in the negative, saying that he had no desire to look at his best friend in death.

It is interesting that the patient heard of these wounds and deaths among his comrades during the next weeks that he remained with the unit, but he was never able to recover his memory for the part he had played on the morning of the catastrophe until after treatment. He found that it was convenient to walk away when conversation turned to these comrades, because it made his head worse, gave him a feeling of nausea and caused precordial pain when he heard about them.

After treatment the patient had mixed feelings of relief for the restoration of his amnesia and grief for the loss of his friends. He slept poorly that night, and the next day he was quiet but obviously upset. He was told that he had best write it all down, that he would have to learn to live with this knowledge. For the next few days he was encouraged to speak freely about these friends. He continued to have headache, although it was not so severe as it had been before treatment. On the fourth post-treatment day he spent a long time talking about Downs, telling many anecdotes about him. That night he slept better and seemed to be reconciled to the emotional trauma of the experience after that. Because he was underweight, he was transferred to another ward, given a course of modified insulin therapy, which permitted him to regain his lost weight, and then was transferred to the rehabilitation section. He was discharged to limited duty. At the time of discharge he regarded himself as much improved. He complained of occasional mild headaches when he was around loud noises.

Case 4 illustrates how the pentothal-nikethamide technic was successful after chemical hypnosis with both ether and pentothal had failed. This patient was probably one of the most anxious in the series, and the relief of his symptoms after successful treatment was a pleasure to observe.

CASE 4.—T. M., private first class, a tank driver aged 29, entered the hospital March 6, 1945, with a diagnosis of blast concussion, sustained Feb. 28, 1945 in a small village near the Roer River in the Rhineland. He complained of a constant dull headache, which extended across the top of his head from both temporal areas. He had had intermittent tinnitus for six days in both ears, as well as a floaty dizziness. He was extremely sensitive to noise and was severely startled by sudden noises, and he had a pronounced tremor of the outstretched hands. His lips were tremulous, and a tremor was evident in his voice. He complained of feeling inwardly "jittery" at all times, and he had difficulty in going to sleep. He dreaded the night because of his vivid recurrent combat dreams, in which he wakened in terror, drenched in sweat. In the ward he was restless and seclusive. He wore a constant expression of fear and said that he felt frightened all the time. He had always regarded himself as a stable person and had little occasion to consult doctors in the past. He had been in combat for four months and had been wounded by shrapnel in the chest and neck on a previous occasion.

His history revealed that he had parked his tank, gone into a house and was preparing for bed when large artillery shells began to crash all around him. He remembered one striking the house, and he surmised that it must have landed directly in the room where he and his comrades were. The next thing he remembered clearly was of being carried out of a battalion aid station on a litter and of being transported to the rear on a "weasel," a small tracked vehicle.

General physical and neurologic examinations revealed nothing abnormal except for somewhat dilated pupils, an appearance suggestive of exophthalmos, tremor of the hands and lips, hyperhidrosis, a pulse rate of 108 and sighing respirations. Lumbar puncture released a clear fluid under 150 mm. of pressure, which contained no red cells, 2 white cells per cubic millimeter and 31 mg. of protein per hundred cubic centimeters.

On March 6, 1945 he was treated by chemical hypnosis, using ether by inhalation. He became excited, repeating "Siler, Siler, come on; let's get out of here! This place is on fire; we'll burn up!" It was impossible to control him properly to carry out a systematic inquiry into his amnesia, and the treatment was abandoned. Afterward he was extremely agitated, saying that he remembered the house being on fire and recalled wandering from room to room, holding Siler by the hand, looking for an exit. Another soldier, Baldy, would not permit them to go out through the kitchen door because there were snipers outside on that side of the house.

The patient could not recall any more of his experience during the next two days, and his condition of acute anxiety and restlessness, with severe headache, continued. On March 8 he was treated a second time, using sodium pentothal. A more connected story was given. He told of parking his tank, going into the house, cooking supper and going into a bedroom with Siler and Moneta, two members of the crew of his tank. He remembered a blinding flash, then saw bricks and rubble tumbling all about him. The air was so full of brick dust that he could not see, and he remembered his mouth being so filled with dust that he could not spit. He groped around and found Siler lying on a bed, blood covering his forehead. He grasped the wounded man by the wrist and jerked him to his feet. He called for Moneta, but received no reply and could not locate him with his hands. Holding tight to Siler, he started for the kitchen door, but Baldwin, who had been standing guard, told him that snipers were out in the rear, that he should leave by the front. By that time fire had broken out, and the house was filling with smoke. He worked his way to the front, still holding to Siler's wrist,

kicked out a window and found himself on the road. Siler complained that the patient was hurting him with the viselike grip on his wrist, but he would not let go. They moved up the road, walking along a stone wall. As more shells came in, they crouched between the wall and an abandoned tank. When the shelling slackened, they walked along about 300 yards (275 meters) to the left, where they found a medical soldier in a doorway. He tried to take Siler away from the patient, but he would not let go of the man's wrist until he got him to a doctor. The doctor took them inside and convinced the patient that they were in an aid station and that Siler would be taken care of; the patient then released his grip and allowed Siler to be taken from him. Another medical soldier came by and noticed the patient wandering about aimlessly, shaking from head to foot. He put him on a litter in the hallway and piled blankets on him, but he continued to shake violently. As he lay there in the dark, somebody stumbled into him and kicked him in the head. He swore and tried to get up to fight the man who kicked him but did not have the strength to stand. Then two corpsmen came by, put a tag on him and carried him outside to a "weasel." When the motor of the vehicle was started, the patient returned to consciousness.

The material was reviewed; and then, with appropriate sound effects, the patient underwent a violent abreaction in reliving the amnesic material. This treatment was carried out before we had begun to use nikethamide, and the patient was removed to the ward at the end of his abreaction. There he continued to relive the amnesic episode and tried to break the window near his bed. Four men were required to hold him down, and because he continued to struggle and shout it became necessary to restrain him and to quiet him with paraldehyde.

Later that day he became calm but remained tense and frightened. His headache had not improved, and he was extremely restless during the night which followed. On the next day he was unable to recount the amnesic experience in any detail, even after notes taken during the treatment had been read to him carefully. He remembered wandering through the house and recalled that he dared not let go of Siler's wrist, but little else was clear to him. In the next days the amnesic material was reviewed for him repeatedly, but he was unable to recall it properly. He pounded his forehead and said, "I can't get it! I can't see it like it was, except a bit here and there." His symptoms of headache and acute anxiety persisted, and tormenting dreams continued to disrupt his sleep.

On March 20 he was treated a second time by chemical hypnosis induced with sodium pentothal. His account was similar to the former one, and a few details were added. After the recital of his amnesic experience, it was reviewed for him. Then, with the use of sound effects, he underwent an active abreaction once more. Then 10 cc. of nikethamide was given intravenously. He reddened, coughed and sneezed for thirty seconds. Then he was fully awake. He was asked to recount the amnesic experience immediately. He looked up; a pleasant smile of discovery crossed his face, and he said, "Now, now I can see it, just like it happened." He raced through the narrative, stopping at intervals to remark that the whole picture was clear in his mind. He was buoyant about his memory recall, after almost two weeks of struggling to accomplish it after the previous treatment. His sleep that night was better, and the next day he volunteered the information that his head was "clear," that it no longer had the dull heavy ache of which he had complained before. During the next few days he continued to improve, and he showed himself to be a person of good humor and affability, traits that he had not shown before. He expressed relief that his frightened feeling was

gone, that he now slept well and that he was no longer bothered by weird, mixed-up dreams.

He was transferred to the surgical service for the removal of a piece of shrapnel under the skin of the right side of his jaw, which had given him discomfort while shaving, and then was transferred to the rehabilitation section. There he was placed on duty as a cook, and in a two month period of observation there he was without complaints and had no occasion to report at sick call.

Case 5 is included to demonstrate the relatively rare but striking phenomenon of pathologically vivid recall of amnesic material. This patient recalled the events of his postblast amnesia so vividly after chemical hypnosis that for almost four days after treatment the episode seemed to flood his entire consciousness. It was not until the recalled memories had lost their excessive vividness that the patient began to improve.

Case 5.—A. B., sergeant, assistant squad leader of a rifle squad, aged 25, entered the hospital March 1, 1945, with a diagnosis of blast injury, sustained Feb. 23, 1945, near the Roer River in Germany

On admission the patient complained of a severe frontal headache, which was constant, but which varied in intensity and in quality from dull to sharp to pounding. He held his head cupped in his hands and said that he had never experienced anything so intense. He complained of bilateral tinnitus as well but said that it was not constant like the headache. Any movement of his head produced a floaty dizziness. All noises caused him to wince with pain, and he jerked in a startle reaction to them. He complained of a tremor of the hands and of feeling excessively fatigued. He said that his eyes felt weak and sore, and he avoided bright light. His sleep was interrupted by battle dreams, in which he saw every one around him wounded and heard their cries for help. He spent most of the day on his bed and was completely apathetic toward everything about him. This behavior appeared to be inconsistent with his past performance. He had been a college student, hoped to become a teacher of music and was interested in dramatics. He admitted that he was not himself: When he was well he was a gregarious person and an avid reader.

He stated that his unit had crossed the Roer River during the early hours of Feb. 23, 1945, before daylight and had dug in on the far side. The Germans counterattacked with tanks and infantry and were met with rifle fire and grenades. American artillery fire was called for in support and began to fall among the advancing Germans. Then shells began to rain down all around the patient. He heard the cries of wounded men and managed to drag two members of his squad into his hole. One was wounded in the leg, the other, in the chest. One of the men asked him to pray for them, and he began to do so, when he heard a loud whiz and saw a blinding flash and then lost consciousness. The next thing he remembered was lying on a pile of straw in a cellar on the far bank of the river. It was fully light, and the patient estimated that he had been unconscious for approximately two hours.

General physical and neurologic examinations revealed nothing significant except for multiple abrasions about the face and tremor of the outstretched hands. Speech was slow; mood was flattened, and his face wore an expression of tension and pain. Lumbar puncture released clear fluid under 110 mm. of pressure, con-

taining no red cells, 4 white cells per cubic millimeter and 31 mg. of protein per hundred cubic centimeters.

On March 4, 1945 light sleep was induced with 14 cc. of sodium pentothal injected intravenously after premedication with atropine. Within a minute the patient was able to respond to his name. He was told to begin to talk about the assault crossing of the Roer River during the night of February 23. In a slow, careful manner he began to describe the events of those hours. When he talked about seeing enemy tanks and infantrymen approaching his hole, he struggled violently to get off the table and required the manual restraint of four attendants. He continued to tell his story, but every new event made him struggle for freedom. It was necessary to inject sufficient pentothal to keep him in a deeply drowsy state in order to prevent his struggles. He fell off to sleep again, and it was necessary to wait about three to four minutes before he was sufficiently roused to continue his story. Then he told of an incessant barrage of shells and of hearing one of his squad members, Green, calling for help. He stuck his head out of his hole and saw that Green was lying to his right. He wiggled out of the hole, grasped Green by the left foot and dragged him down into the hole. Then he heard Nolan shouting to his left. He called to Nolan to crawl his way, as he went out to meet him. The second man was assisted into the hole. Green was crying, asking that prayers be said for him. Nolan and the patient managed to dress Nolan's leg wound and to prop Green up in the sitting position. He had a chest wound and was having difficulty in breathing. Then, in the midst of the barrage, both men asked the patient to pray. He was known as a sincerely religious person and had led the unit in prayer on previous occasions. He began to pray, when he heard a loud whizzing noise close by and then saw a blinding flash. In his own words, as he wrote it later, he said:

"I don't know how long we remained in prayer, but I remember a real close whiz as it was coming in and then a big flash. Then I saw that this shell had landed on the edge of the foxhole. Everything was so quiet all up and down the battle front, it seemed as though the whole world was at peace with God and man. The barrage had stopped suddenly. I called the name of the boy who was wounded the worst; but no answer. It was dark in the hole; so I felt for him and found him almost covered with dirt. I pulled him out and shook him to try and bring him to. I started to place my hand on his head to try to arouse him. His head was gone, and when I felt the blood and flesh I think I went out again."

He was roused by Nolan's voice. The other man was unable to move because of his leg wound. The patient crawled out of the hole and staggered about 50 feet (15 meters) to his left to a pillbox which was being used as his platoon command post. At the entrance to the pillbox he met a soldier by the name of Brown and tried to tell him about Nolan, but he was shaking so badly that he could not talk. Brown took him inside and had the patient lie down on a pile of rags and threw a blanket over him. Shortly thereafter an amphibious vehicle, a "duck," came by the pillbox, and the patient was loaded on the vehicle and carried back to a concentration point, where a group of prisoners were herded together. He was told by the driver that he could go no farther, and the patient was advised to follow the prisoners back to the river.

He found walking difficult and was unable to keep up with the file of prisoners, but he managed to keep them in sight as he staggered along. He finally reached the river, where a treadway bridge had been thrown across. Just then a barrage of enemy shells, intent on knocking out the bridge, began to fall near the patient. He rolled into a ditch, then got up and staggered across the bridge when the

shelling had abated. On the far side he wandered aimlessly up a hill into a village, where a medical soldier found him and took him to a battalion aid station. He recovered consciousness in the cellar of the aid station as he was being given a cup of coffee. He estimated that he had walked and stumbled about 4 miles (6.5 kilometers) in his amnesia.

The amnesic material was reviewed for him, and he continued to struggle to leave the table as each event was mentioned. Then the needle was withdrawn. Twenty-eight cubic centimeters of pentothal sodium had been administered. When the sound of shells was simulated by whistling and appropriate noises, the patient became so frenzied that it was almost impossible to hold him. At the suggestion that he pray, he broke into eloquent supplication, with tears streaming down his face. During the remainder of this violent abreaction he continued to cry copiously, calling on God to help his stricken comrades.

At the end of his abreaction the patient was physically exhausted and drenched in sweat and continued to pray through his tears. We had not hit on the nikethamide technic at that time, and he was permitted to remain in the treatment room for the next hour with two corpsmen. He cried and prayed for twenty to thirty minutes; he then realized his surroundings and rested more comfortably.

Later that day he was visibly upset and said that his headache was severe. That night his sleep was poor because he kept reliving the amnesic episode over and over again. For the next three days he could think of hardly anything else. He tried to play checkers, a game which he liked, but could not concentrate on it. He attempted to go to the cinema at the post on two occasions but abandoned it because he could not interest himself in the picture. He wrote two long letters, one to his mother and one to his sweetheart, describing the amnesic episode, apologizing for the gruesome subject, but saying that he could think of nothing else and felt impelled to write about it. The letters were withheld from mailing, and later the patient was happy that they had not been forwarded. Other patients on the ward avoided him because his only topic of conversation was the amnesic episode.

On the fourth day he seemed brighter and no longer held his head in his hands. He said that he was no longer troubled by the constant "picture" of his amnesia, and he managed to spend part of the day reading a novel. That night he slept better; and on the next day he reported that his head felt better, he no longer felt his excessive fatigue and the heavy feeling in the precordium had lifted. He had concluded that the events which occurred at the time of his blast injury were the will of God, and he was reconciled to it, although the decapitation of Green would always be hard to contemplate. His progress after that was rapid, and on the eighth post-treatment day he was transferred to the rehabilitation section.

There he was found to be an excellent noncommissioned officer, and he was retained as a member of the staff. During the two and a half months (at the time of writing) he has worked in that capacity he has been free of complaints, has won himself the high regard of his officers and has had no occasion to report at sick call.

1027 Carew Tower, Cincinnati 2.

MECHANISM OF MOTION SICKNESS

GUY MORTON, M.D.

ANDRE CIPRIANI, M.D.
AND
DONALD McEACHERN, M.D.
MONTREAL, CANADA

SEASICKNESS is a serious inconvenience to many people in times of peace. In times of war, however, motion sickness in its various forms may be a very real threat to the success of operations in the air and on the sea. Army personnel are apt to be affected in very large numbers, when airborne or in landing craft, since they have little opportunity to become acclimatized, as does the sailor or the airman.

The literature on motion sickness up to 1942 has been reviewed elsewhere.[1] Since that time a large amount of important work has been done, but publication has been in restricted reports. It is hoped that various workers will soon write up their results for open publication.

The present paper is a summary of studies carried out during the recent war by a group of workers in Montreal of which we were a part. These experiments on the mechanism of motion sickness were made at an early stage of the investigation in the hope that they might give a lead to specific therapy. Later, through urgency, all our attention was devoted to therapeutic experiments. It is probable, however, that if worth while advances are to be made in therapy more must be known of the fundamental mechanism of motion sickness.

MATERIALS AND METHODS

Many hundreds of human volunteers were subjected to various types of motion. The majority were naval ratings from H.M.C.S. Montreal, but University students and members of the staff of the Montreal Neurological Institute also volunteered.

The device first used was designed to reproduce the wayward movements of a ship at sea. This was called the "Roll-Pitch Rocker," or, more commonly, the

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From the Department of Neurology and Neurosurgery, McGill University, and the Montreal Neurological Institute.

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1. (*a*) McEachern, D.; Morton, G., and Lehman, P.: Seasickness and Other Forms of Motion Sickness, War Med. **2**:410 (May) 1942. (*b*) McNally, W. J., and Stuart, E. A.: Physiology of the Labyrinth Reviewed in Relation to Seasickness and Other Forms of Motion Sickness, ibid. **2**:683 (Sept.) 1942.

"S.S. Mal-de-Mer," and was installed in the squash court of the Montreal Neurological Institute. It consisted of a giant rocker which rolled from side to side. On this was a counter-weighted seesaw, at one end of which the subject was seated. The seesaw moved up and down like a ship pitching. The device[2] is pictured in figure 1. The two motions (roll and pitch) could be obtained separately or in unison, and either one, at various speeds. The up and down motion was through 12 feet (3.6 meters), and the roll, through 26.5 degrees. This machine reproduced in a very realistic way the movements of a ship.[3]

At a later date, when large numbers of men were to be tested, two simple swings were constructed, as shown in figure 2. These had a maximum radius of 14 feet (4.2 meters), a period of 15 complete cycles per minute and a total arc of 90 degrees. An electromechanical drive for these swings was designed to permit their automatic operation.[4] Similar hand-operated swings were used for animals, the cage being placed at the end of the pendulum.

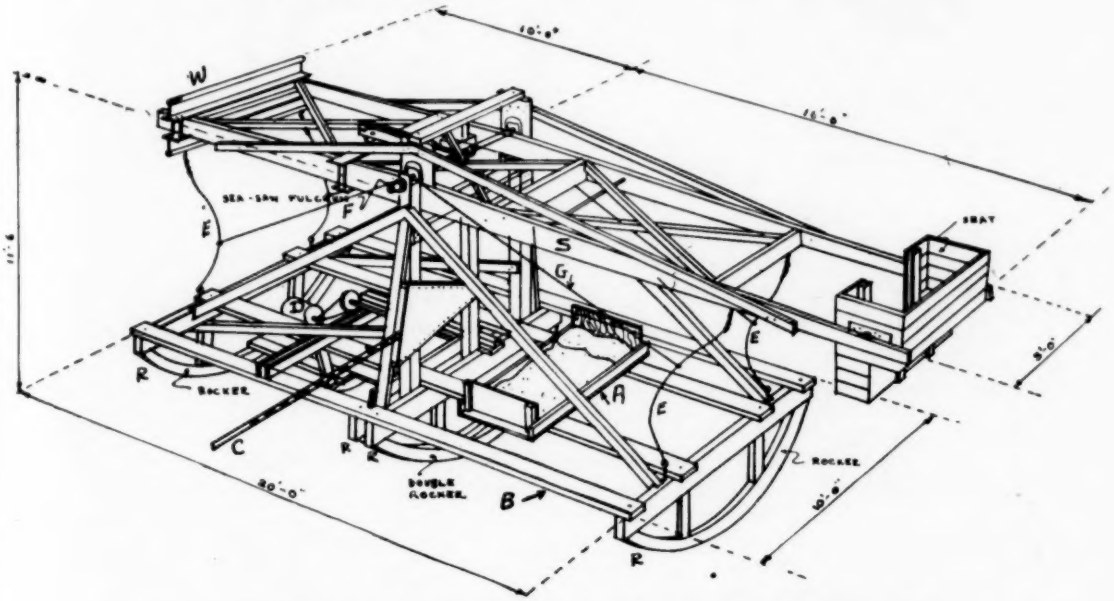

Fig. 1.—Sketch of the motion sickness machine used at the Montreal Neurological Institute. Here, *B* indicates base of machine (some of the longitudinal bracing of the machine has been omitted); *R*, rockers (restraining cables attached to the end rockers are not shown); *C*, connecting rod for rocking motion drive (drive is not shown); *F*, seesaw fulcrum; *S*, seesaw beam, showing manner of bracing; *W*, counterweights; *D*, seesaw drive; *A*, bed fixed to base; *E*, damping springs and cables, and *G*, rope which keeps damping spring cable from catching the woodwork.

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2. Factors of acceleration built into this machine were based on experience which we gained on so-called pleasure devices at Belmont Amusement Park, near Montreal.

3. Cipriani, A., and McEachern, D.: Montreal Motion Sickness Machine, in Proceedings of the Conference on Motion Sickness, National Research Council of Canada, Report no. C 615, Aug. 28, 1942.

(Footnotes continued on next page)

OBSERVATIONS

Symptoms.—It is not necessary to describe the symptoms of motion sickness. It may be of interest, however, to note their incidence as observed in 175 Naval ratings and 42 miscellaneous subjects who were exposed to motion on the large machine.

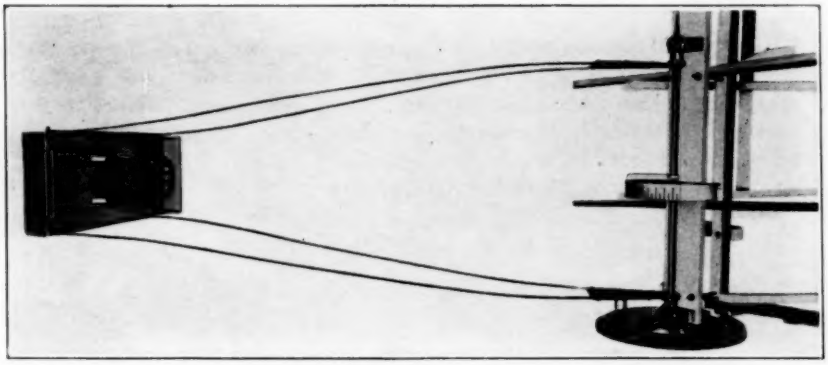

Fig. 2.—Simple swing.

Effective Types of Motion.—There was a curious variability in the incidence of motion sickness, dependent on relatively minor changes in the type of motion. This matter is still beclouded, but certain facts emerged from our work. In table 2 will be seen the incidence of sickness with different types of motion on the roll-pitch rocker.

TABLE 1.—*Incidence of Symptoms Produced by Large Machine*

	175 Ratings, %	42 Miscellaneous Subjects, %
Epigastric awareness	48	60
Pallor	47	43
Malaise	42	45
Nausea	43	57
Vomiting	30	33
Sleepiness	19	14
Yawning	18	28
Headache	17	21
Sweating	17	21
Abdominal cramps	2	7
Salivation	2	21

It will be seen that the pitching motion was as effective by itself in producing illness as was the combined pitch and roll. Furthermore,

4. Cipriani, A.: A Mechanical Drive for the Simple Swing Used in the Study of Motion Sickness, in Proceedings of the Fourth Meeting of the Subcommittee on Seasickness, National Research Council of Canada, Report no. C 2245, Nov. 27, 1942.

for each increase in the number of pitching motions per minute there was an increased incidence of sickness, at least up to a certain point.

Further evidence that pure up and down motion is effective was obtained in a small number of subjects exposed to the up and down motion of an express elevator in the Sun Life Building, Montreal. The elevator moved through a distance of about 5 meters, and the accelera-

TABLE 2.—*Incidence of Sickness with Different Types of Motion*

Group	Number of Subjects	Motion, Cycles per Min.		Vomiting		Illness	
		Seesaw	Rocking	No.	%	No.	%
1	10	5-5½	6½-8	1	10	1	10
2	15	7½	0	6	40	8	53
3	6	7½-8	5	2	33	3	50
4	186	8-11½	6½	68	37	115	62

tion level was approximately 0.275 g. The maximum speed was approximately 4 meters per second. Four out of 5 subjects tested became sick in a period of ten to thirty minutes.

Accelerometer records taken during the pitching motion of the roll-pitch rocker and the measured values of radial acceleration for the simple swing used by us are shown in figure 3. Mathematical analysis of the forces encountered on the simple swing would indicate that radial acceleration in the long axis of the body with the subject sitting upright

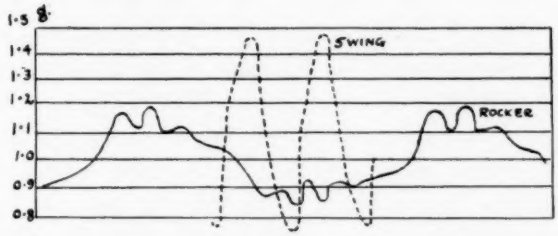

Fig. 3.—Accelerometer readings taken on the pitch-roll rocker and the standard swing. The period of the rocker due to pitch was 8 cycles per minute; the period of the swing, 15 cycles per minute.

is one of the principal vestibular stimuli encountered in the simple swing.[5] In attempting to determine the various positions and forces most productive of motion sickness, it is essential that the position of the subject's head be fixed, and in our later experiments the head was always confined by a specially designed head rest.[6]

5. Cipriani, A.: An Analysis of the Forces Encountered on the Simple Swing Used in the Study of Motion Sickness, in Proceedings of the Fourth Meeting of the Subcommittee on Seasickness, National Research Council of Canada, Report no. C 2246, Nov. 27, 1942.

(Footnotes continued on next page)

The time necessary to produce sickness varies with different subjects, but in our later work it became the rule to make runs of only thirty minutes, since few subjects became ill after this time even if the run was continued to sixty minutes.

Susceptibility to Motion and History of Motion Sickness.—The relation between past history of motion sickness on ship, plane or train and susceptibility to motion on the machine is shown graphically in figure 4. This study was made in collaboration with Surg. Lieut. William Fields. The data may be analyzed as follows:

Number of Subjects	History	Severe Symptoms Within 30 Min. on Machine	
		Number	Per Cent
26	Resistant	1	3.9
108	Unknown	34	31.8
41	Susceptible	28	68.3

It will be seen that there is good correlation between past history of susceptibility and results on the machine.

Acclimatization.—Efforts were made to avoid acclimatization in subjects used more than once by requiring an interval of at least one week between two successive exposures to motion. In 1 very susceptible subject, an airman who had been grounded because of recurring air sickness, an attempt was made to produce acclimatization by repeated daily exposure to motion for twenty-three successive days.[7] Some tolerance was built up, but this was not very striking. The degree of adaptation produced in this subject by many repeated exposures was not sufficient to enable him to resume his former duties as air observer.

History of Susceptibility in Relation to Instability in the Electroencephalogram.—In view of a suggestion that persons subject to motion sickness showed a certain instability in the electroencephalogram, it was decided to question 87 McGill medical students on whom electroencephalograms had already been taken. The records and history of susceptibility to motion sickness were reviewed by Dr. H. H. Jasper, who found no correlation.[8]

Vestibular Responses in Caloric Test in Relation to Motion Sickness.—In order to test the correlation between caloric vestibular responses and susceptibility to motion on the machine, 31 volunteers were tested

6. Fields, W. S., and Cipriani, A.: Adjustable Head Rest for Swing, Proceedings of the Sixth Meeting of the Subcommittee on Seasickness, National Research Council of Canada, Report no. C 4032, March 24, 1943.

7. Morton, G., and McEachern, D.: Experimental Studies on a Susceptible Individual, in Proceedings of the Conference on Motion Sickness, National Research Council of Canada, Report no. C 750, Aug. 28, 1942.

8. Jasper, H. H., and Morton, G.: Electroencephalography in Relation to Motion Sickness in Volunteers, in Proceedings of the Conference on Motion Sickness, National Research Council of Canada, Report no. C 745, Aug. 28, 1942.

by Dr. W. J. McNally and Dr. E. A. Stuart. Three cubic centimeters of ice water was used as stimulus, and the time of onset of nystagmus and past pointing and the patient's subjective complaints were recorded. Twenty-five of the subjects were given a test on the machine, but no correlation could be found between their vestibular responses and their liability to motion sickness. Of the 7 patients who showed the most active responses to the caloric test, 2 vomited when on the machine, 2 complained of minor symptoms and 3 were unaffected by motion.[9]

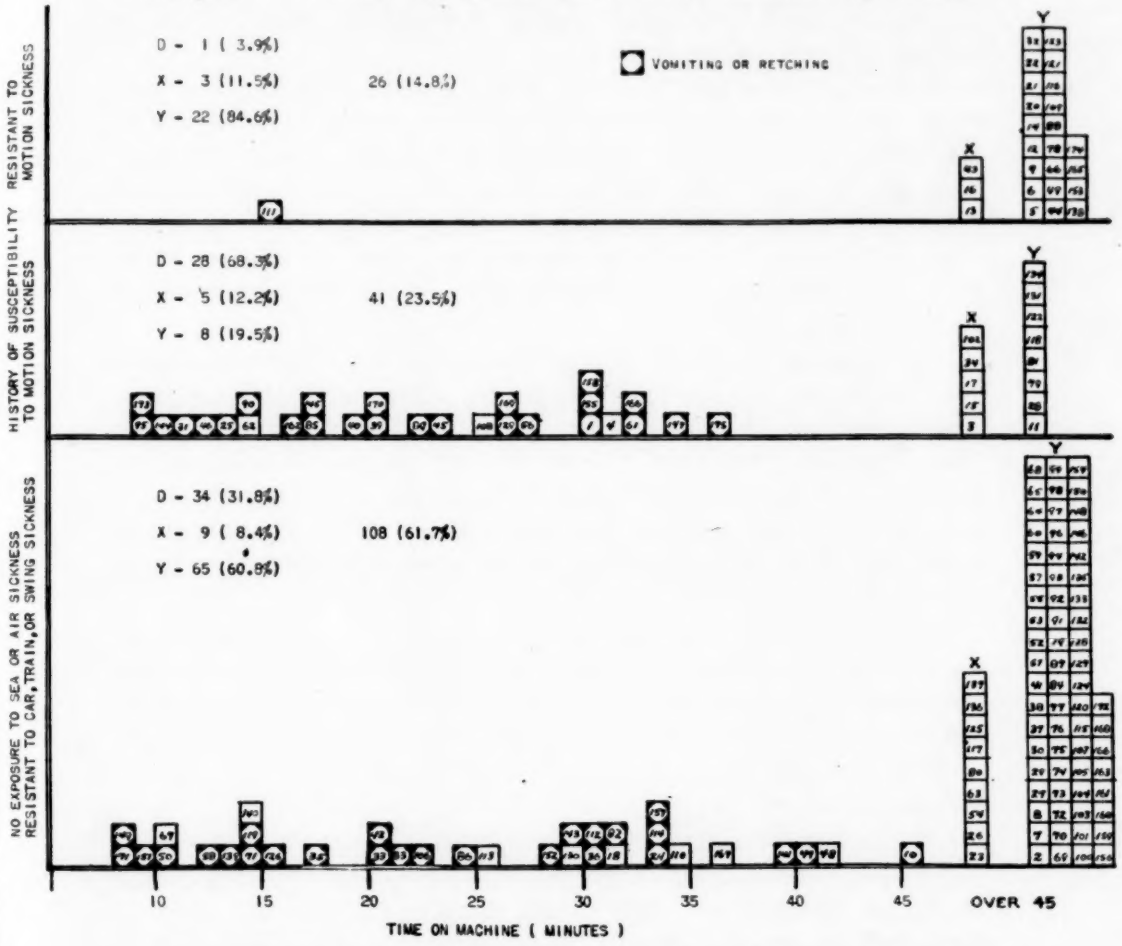

Fig. 4.—Graph showing relation between susceptibility to motion on the machine and a history of motion sickness for 175 Naval ratings. *D* indicates that motion was discontinued (63 of the 175 men, or 36 per cent); *X*, that symptoms of illness occurred at cessation of motion (17, or 10 per cent), and *Y*, that illness did not occur as a result of the experiment (95, or 54 per cent).

9. Morton, G.; McNally, W. J., and Stuart, E. A.: Caloric Vestibular Tests in Relation to Susceptibility to Motion Sickness, in Proceedings of the Conference on Motion Sickness, National Research Council of Canada, Report no. C 743, Aug. 28, 1942.

Physiologic Observations During Motion.—By ingenious methods of recording, it was possible to take an electrocardiogram, an electroencephalogram and records of the respiratory excursion and the blood pressure on some of the subjects before, during and after motion.

Electrocardiogram: From one lead records were obtained on an ink-writing oscillograph from 23 subjects, in 13 of whom sickness occurred. There was no constant change in the heart rate or the configuration of waves as a result of motion. In 12 subjects in whom sickness occurred the average change in heart rate was +6; in 10 patients without sickness it was —6.

Respiratory Rate and Rhythm: These were recorded on 22 subjects by means of a respiratory belt connected to a rubber tambour and an ink-writer. Except for a slight reduction in respiratory rate in most cases and the rather frequent presence of large sighs, there was little change. Yawning and sighing are rather common premonitory symptoms of motion sickness. In 1 subject tetany developed from hyperventilation. His respiratory rate rose from 13 to 34 and his heart rate from 96 to 148, per minute.

Electroencephalograms: Records were taken from 23 subjects, using one central lead and one lead attached to the ear lobe. No consistent abnormality was found in subjects who experienced motion sickness. The usual finding was a damping of the alpha waves early in the experiment, both in subjects who became motion sick and in those who did not. This was attributed to a moderate degree of initial apprehension on the part of the subject. These records were reviewed by Dr. H. H. Jasper.

Blood Pressure: Records of blood pressure were obtained from 4 subjects by means of a microphone placed over the brachial artery and connected to ear phones in the observation gallery. Readings were made before, during and after motion. No significant abnormality was found.

Details of the physiologic observations described will be found in the original report.[10]

Blood Chemistry.—Determinations of the sugar, calcium, phosphorus, sodium and potassium contents of the blood were made before and after motion on 13 subjects.[11] The results are given in table 3. Three of these subjects vomited, 5 had illness without vomiting and 5 were unaffected. One significant change was an increase in blood sugar,

10. Cipriani, A., and Morton, G.: Studies of Blood Pressure, Electrocardiograms and Respiratory Tracings in Volunteers, in Proceedings of the Conference on Motion Sickness, National Research Council of Canada, Report no. C 744, Aug. 28, 1942.

11. Fields, W. S.; Meakins, J. C., and McEachern, D.: Blood Chemistry Studies in Motion Sickness, in Proceedings of the Conference on Motion Sickness, National Research Council of Canada, Report no. C 740, Aug. 28, 1942.

TABLE 3.—*Chemical Constituents of Venous Blood of Thirteen Human Subjects Before and After Motion*

Subject No.	Reaction	Blood, Mg./100 Cc. Glucose			Serum, Mg./100 Cc. Calcium			Phosphorus			Sodium			Potassium		
		Before	After	Difference	Before	After	Difference	Before	After	Difference	Before	After	Difference	Before	After	Difference
1	Illness and vomiting	107	107	0	10.5	11.2	+0.7	3.26	3.03	—0.23	336	337	+ 1	16.3	16.45	+0.15
2	Illness and vomiting	87	128	+41	12.5	12.5	0	4.75	4.23	—0.52	...	...	....	14.90	14.25	—0.65
3	Illness and vomiting	100	152	+52	....	....	.....	2.98	2.93	—0.05						
	Average.....	98	129	+31	11.5	11.9	+0.4	3.66	3.40	—0.26	...	...	....	15.6	15.35	—0.25
4	Illness.....	83	106	+23	11.0	10.6	—0.4	3.83	3.40	—0.43	336	339	+ 3	13.5	15.55	+2.05
5	Illness.....	99	110	+11	11.0	10.6	—0.4	4.61	4.23	—0.38	...	...	....	16.15	15.21	—0.94
6	Illness.....	89	114	+25	10.4	10.4	0	....	....	.....	339	343	+ 4	15.60	15.05	—0.55
7	Illness.....	90	142	+52	11.6	11.8	+0.2	3.83	3.70	—0.13	357	346	—11	15.95	16.60	+0.65
8	Illness.....	111	125	+14	....	....	.....	3.70	3.76	+0.06						
	Average.....	94	114	+25	11.0	10.9	—0.1	3.99	3.77	—0.22	344	339	— 5	15.3	15.6	+0.30
9	None.....	100	126	+26	12.3	12.3	0	4.50	3.37	—1.13	329	333	+ 4	15.45	16.16	+0.71
10	None.....	...	...	....	11.1	11.2	+0.1	3.95	3.40	—0.55	337	335	— 2	15.25	16.20	+0.95
11	None.....	108	110	+ 2	....	....	.....	2.62	2.51	—0.11						
12	None.....	85	87	+ 2	....	....	.....	3.95	3.83	—0.12						
13	None.....	117	101	—16	....	....	.....	2.93	2.72	—0.21						
	Average.....	102	106	+ 4	11.7	11.8	+0.1	3.59	3.17	—0.42	333	334	+ 1	15.35	16.18	+0.83
	Total average.....	98	117	+19	11.3	11.3	0	3.74	3.42	—0.32	339	339	0	15.39	15.68	+0.29

which occurred in 11 of the 13 subjects whether illness was present or not and which ranged from 2 to 52 mg. per hundred cubic centimeters. There was also a reduction of blood phosphorus in 11 of the 13 subjects, ranging from 0.05 to 1.13 mg. per hundred cubic centimeters. No significant changes occurred in the other bases. The reason for these alterations in the sugar and phosphorus levels of the blood are not clear. It is possible that they result from the release of epinephrine, due either to the motion or to apprehension.

An attempt was made to study blood gases in the human subject, but this had to be abandoned because of difficulty in obtaining arterial blood immediately after motion. The experiments were therefore performed on dogs, using a simple pendulum swing.[12] Specimens of arterial blood were taken from each animal immediately before and after motion,

TABLE 4.—*Values for Blood Gases in Blood of Dogs Subjected to Pendulum Motion*

Dog No.	Comment	Period of Motion, Min.	Carbon Dioxide Content, Vol. %		Oxygen Content, Vol. %		Oxygen Capacity, Vol. %		Oxygen Saturation, Vol. %	
			Before	After	Before	After	Before	After	Before	After
1	Vomiting	6	31.1	25.4	21.7	17.8	24.04	23.41	90.2	76.1
2	Vomiting	17	40.3	42.2	15.8	18.0	16.9	20.3	93.5	88.7
3	Vomiting	10	39.5	36.7	17.7	18.9	18.8	20.3	94.1	93.1
4	Vomiting	5½	36.15	34.05	17.01	18.45	18.2	18.82	93.4	98.0
5	Vomiting	6	36.8	35.6	16.45	17.3	18.2	19.2	90.4	90.1
6	Illness but no vomiting	30	32.8	31.2	17.6	19.0	18.8	19.0	93.6	100
7	No vomiting	30	34.2	34.1	18.2	18.9	20.9	21.5	87.1	88.2
8	No vomiting	35	30.4	29.3	19.65	20.6	20.9	23.4	94.0	88.0
9	Labyrinthectomy; no vomiting	30	35.5	42.1	17.0	15.0	17.8	17.8	95.5	84.3
10	Labyrinthectomy; no vomiting	30	44.8	45.5	20.8	19.4	21.5	21.5	97.0	90.5
11	Labyrinthectomy; no illness	60	41.05	43.45	16.92	16.86	17.15	18.3	98.7	92.1
12	Labyrinthectomy; no illness	60	41.87	37.2	17.09	18.06	18.18	18.18	94.0	99.3
13	Control	..	32.55	33.7	15.91	15.66	16.5	17.55	96.5	89.3
14	Control	..	32.85	32.07	16.35	16.75	17.77	17.77	92.0	94.2
15	Control	..	40.32	39.1	16.8	16.72	17.97	19.02	93.5	87.9

by puncture of either the femoral artery or the left ventricle of the heart. The premotion specimens were taken within sixty seconds of the commencement of motion, and the postmotion specimens, within sixty seconds of cessation of motion. Samples were collected under oil in the usual way, and estimations made of the carbon dioxide content, the oxygen content, the oxygen capacity and the oxygen saturation. The animals were divided into three groups. Group A (6 dogs) included those which vomited or were ill as a result of motion; group B (6 dogs), those which showed no evidence of motion sickness; group C (3 dogs), those which were subjected to the experimental procedure except that

12. Meakins, J. C.; Morton, G., and McEachern, D.: Studies of Blood Gases in Animals, in Proceedings of the Conference on Motion Sickness, National Research Council of Canada, Report no. C 747, Aug. 28, 1942.

they were placed in the motionless swing for thirty minutes. The results are shown in table 4. There were no significant changes in the blood gases of these animals in a series of 15 experiments.

Changes in Cerebrospinal Fluid Pressure During Motion.—Observations were made on 1 human subject during repeated up and down motion of an express elevator moving through a distance of about 5 meters at a maximum speed of 4 meters per second. The subject was in an upright position. Pressures were measured with an isometric manometer attached to a needle placed in the subarachnoid space in the lumbar region. Recording was done by means of motion picture photography, so that the film simultaneously showed (1) oscillation of cerebrospinal fluid pressure, (2) acceleration and deceleration of the elevator, recorded by an accelerometer and (3) time, recorded by a stop watch.

At times when the elevator was reversing direction there were changes in cerebrospinal fluid pressure amounting to 70 to 85 mm. of water. Maximum pressures, of 460 mm. of water, were recorded at the point at which the elevator stopped descending; minimum pressure readings, of 375 mm. water, were recorded when the elevator stopped ascending. The acceleration was approximately 0.275 g.

Animal Experiments.—An attempt was made to produce motion sickness in animals by means of a simple swing.[13] Cats were found to be unsuitable. In 14 experiments on 6 animals, vomiting occurred in only 3 instances. Two experiments were carried out on 2 monkeys, but no vomiting occurred. In 35 experiments on 20 dogs, vomiting occurred in 26 instances (74 per cent) and no vomiting in 9 instances (26 per cent). Dogs were therefore used in future experiments.

Effect of Labyrinthectomy on Susceptibility in Animals.—Bilateral labyrinthectomy was carried out by Dr. W. J. McNally and Dr. E. A. Stuart on 4 dogs, each of which had previously been found to vomit on several occasions on the swing.[14] Before operation the 4 dogs were subjected to a total of 10 swing experiments and vomiting occurred each time. After operation the 4 dogs were subjected to the same motion on 11 occasions and in no instance did vomiting occur. As an additional check, the 4 animals were subjected to the motion of the express elevator in the Sun Life Building for thirty minutes, over a distance of 5 meters with a maximum speed of approximately 4 meters per second. A normal dog, known to be susceptible on the swing,

13. Morton, G.: Susceptibility of Animals to Induced Motion Sickness, in Proceedings of the Conference on Motion Sickness, National Research Council of Canada, Report no. C 746, Aug. 28, 1942.

14. McNally, W. J.; Stuart, E. A., and Morton, G.: Effect of Labyrinthectomy on Motion Sickness in Animals, in Proceedings of the Conference on Motion Sickness, National Research Council of Canada, Report no. C 748, Aug. 28, 1942.

was in the elevator at the same time. The 4 labyrinthectomized animals were entirely unaffected, whereas the normal dog became apathetic, remained quietly in the corner and showed marked hypersalivation. Bilateral labyrinthectomy therefore caused each of 4 susceptible dogs to become nonsusceptible to motion sickness.

COMMENT

Many different mechanisms have been blamed for motion sickness. These include visual and kinesthetic incoordination, psychologic factors, movement of heavy viscera, chemical influences, vascular instability, carotid sinus reflexes and labyrinthine stimulation. In the 1942 review[1a] the following caution was given:

> . . . Present knowledge of the prostrating symptoms which follow stimulation of the semicircular canals and the dramatic phenomena of Ménière's syndrome have resulted in a general assumption that motion sickness is primarily due to disturbed vestibular function. Although more of the present evidence favors this hypothesis than any other, it is essential that other possible mechanisms be not disregarded until more facts are available. It should be remembered that much of the evidence which tends to incriminate the vestibular apparatus has been obtained by direct stimulation of the labyrinths and not by reproduction of the bodily movements which ordinarily cause motion sickness. Vestibular irritation may not be motion sickness despite the similarity of symptoms.

Work done during the past three years has absolved some of these factors, although they may undoubtedly play a conditioning role. No attempt will be made here to refer to all the wartime work. Much has not yet received open publication.

Incoordination of visual and kinesthetic sensations probably plays a minor role. R. C. A. F. workers[15] showed that ". . . motion sickness is primarily a labyrinthine disturbance which tends to be suppressed or compensated by visual orientation." Certainly, no amount of visual orientation can prevent sickness in susceptible people if they are exposed to the proper type of motion. It is of interest in this respect that Dr. H. H. Jasper and Surg. Lieut. William Fields took moving pictures from the subject's seat in a moving swing. This was shown for over thirty minutes to a group of students seated in a classroom. It did not produce sickness.

Our studies have revealed no chemical changes in the blood which would be likely to play a part in the mechanism of motion sickness. It seems more probable that a humoral transmitter, such as acetyl-

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15. Manning, G. W., and Stewart, W. G.: The Effect of Position on the Incidence of Swing Sickness, in Proceedings of the Conference on Motion Sickness, Co-ordinating Committee for Medical Research, National Research Council of Canada, June 16, 1943.

choline, might appear in the blood in excess, but Babkin and Dworkin [16] were unable to demonstrate this in animals.

Mainland [17] showed that there could be a shift of up to 5 cm. in the position of the heavy viscera as a result of tipping. No correlation was found, however, between lability of the organs and susceptibility to motion sickness. The final proof that this factor is of no importance lies in the swing experiments [15] carried out by the Royal Canadian Air Force. Here the highest incidence of sickness (90 per cent) occurred when men were swung with the body in the horizontal position and the head placed to give maximal stimulation of the utricles.[18] There would in this position be practically no acceleratory force acting on the viscera in a cephalocaudad direction.

These facts minimize the importance of vascular instability or carotid sinus pressor reflexes. Indeed, our own experiments have shown that there is little or no gross disturbance of vascular or respiratory reflexes even if sickness occurs.

There has been a tendency to attribute motion sickness entirely to psychogenic causes. This is quite unwarranted and entirely against the facts. Motion sickness can be produced in practically every one if the right type of motion and proper position of the head are used. It can be produced in animals, but not after the labyrinths are removed. In any large group of men the incidence varies from 0 to 90 per cent, depending on position of the head. In our experiments the young Naval ratings were eager to try the "sickness test." They approached it with bravado, interest or unconcern. There is no question that psychologic factors can play an important conditioning role which may tip the balance, but that is common to most human reactions.

SUMMARY

Motion sickness was produced in human subjects by means of a machine designed to reproduce the wayward movements of a ship at sea. Simple pendulum swings were also effective, although some persons susceptible to one motion did not succumb to the other. Vertical acceleration and deceleration in the long axis of the body with head erect appeared to be the most important element in the production of motion sickness. An increase in the frequency of oscillation resulted in a higher incidence of sickness within the limits of the experiment.

16. Babkin, B. P., and Dworkin, S.: Unpublished report, First Meeting of Subcommittee on Seasickness, National Research Council of Canada, Jan. 27, 1942.

17. Mainland, D.: Unpublished report, First Meeting of the Subcommittee on Seasickness, National Research Council of Canada, Jan. 27, 1942.

18. Howlett, J. G., and Brett, J. R.: A Speculation on the Mechanism of Utricular Response to Stimulation in Motion Sickness, in Proceedings of the Conference on Motion Sickness, Co-ordinating Committee for Medical Research, National Research Council of Canada, Report no. C 2509, June 16, 1943.

There was a definite correlation between history of motion sickness and susceptibility on the machines. Vestibular responses to the caloric test were no guide to a subject's susceptibility to motion, nor was instability of the electroencephalogram.

Electrocardiograms, electroencephalograms and records of blood pressure taken before, during and after motion showed no important abnormality. There were a slight slowing of respiratory rhythm during motion and a rather frequent tendency to yawning or long sighs. Tetany due to hyperventilation was observed in 1 instance.

Determinations of the sugar, phosphorus and other bases in the blood in human subjects showed a moderate increase in sugar and a reduction of phosphorus as a result of motion. These changes occurred whether or not the subject became sick. They were attributed possibly to the liberation of epinephrine, due to motion or apprehension.

Studies of gases in the arterial blood of animals showed no significant change as a result of motion. Changes of cerebrospinal fluid pressure were measured in 1 volunteer in the sitting posture while exposed to motion capable of producing sickness. There was a variation of about 70 to 85 mm. of water with each change of direction of motion.

Dogs were found to be suitable for the study of motion sickness. Cats and monkeys were not. Bilateral labyrinthectomy abolished motion sickness in dogs which had previously been highly susceptible.

It is probable that the most important factor in motion sickness in man is stimulation of the utricles by linear accelerations in the vertical plane of the head.

Montreal Neurological Institute.

THE ELECTROENCEPHALOGRAM AND PERSONALITY ORGANIZATION IN THE OBSESSIVE-COMPULSIVE REACTIONS

FRED V. ROCKWELL, M.D.
AND
DONALD J. SIMONS, M.D.
NEW YORK

IT HAS been observed by Pacella and others [1] that a relatively high percentage of patients with obsessive-compulsive reactions have abnormal electroencephalograms. The present study was made to determine the factors responsible for the presence or absence of abnormal electroencephalographic findings in this group of patients. A promising lead was available in the paper of Simons and Diethelm,[2] in which it was reported that abnormal electroencephalograms were common in certain groups of psychopathic personalities. On the basis of these findings, a study of the obsessive-compulsive reactions from the standpoint of underlying personality organization seemed indicated.

PRESENT INVESTIGATION

The case material for the present study consisted of 24 patients between the ages of 13 and 45 years, all of whom showed well marked obsessive-compulsive symptoms. Many varieties of compulsive actions were encountered, including compulsive washing, cleaning, dressing and toilet rituals, repetition of words, counting, touching and looking. Obsessive phenomena included religious scruples with repeated examination of conscience, obsessive fears and doubts, obsessive thoughts of a sexual or an aggressive nature and various obsessive impulses, e. g., to imitate or to repeat the actions of other people. All the patients showed manifest symptom formation, and none was included merely because of so-called compulsive or obsessional character traits. None of the patients showed any evidence of gross structural disease of the nervous system. All were studied in detail as inpatients at the Payne Whitney Psychiatric Clinic of the New York Hospital, and all had one or more satisfactory electroencephalograms. These 24 patients fell into three groups.

This study was supported by the Barbara Henry Research Fund.

From the New York Hospital and the Department of Psychiatry, Cornell University Medical College.

1. Pacella, B. L.; Polatin, P., and Nagler, S. H.: Clinical and Electroencephalographic Studies in Obsessive-Compulsive States, Am. J. Psychiat. **100**:830-838 (May) 1944.

2. Simons, D. J., and Diethelm, O.: Electroencephalographic Studies in Psychopathic Personalities, Arch. Neurol. & Psychiat. **55**:619-626 (June) 1946.

Group 1.—This group includes the patients who could be considered to have stable and well organized personalities. A patient was considered to have a well organized personality when it could be demonstrated that his attitude toward life and his judgment corresponded to his chronologic age; that he had been able to achieve an average degree of harmony among various strivings, with integration of emotional and intellectual resources, and that he was able to utilize past experiences and to adjust imagination and anticipation to reality. In their illness, these patients showed either uncomplicated obsessive-compulsive neuroses or various mixtures of obsessive-compulsive and affective features. None showed any signs of a disorganizing illness. In this group were 11 patients, 9 of whom had electroencephalograms which were normal according to the criteria of Gibbs, Gibbs and Lenox.[3]

From the standpoint of symptoms and stability of personality organization, the tenth patient did not differ from the 9 who had entirely normal electroencephalograms. Unlike the others, this patient received a course of fifty-five subcoma insulin treatments, which were administered to alleviate severe tension and anxiety. Immediately after the conclusion of this treatment, an electroencephalogram was found to contain an excessive amount of low voltage fast activity, being otherwise normal. A second record, taken three months later, was entirely normal. It was felt that, for the purposes of this study, the patient belonged essentially in the category of the first 9 patients of this group.

The eleventh patient, like the first 10, was a well organized person, whose leading symptoms were depression, obsessions and compulsions. Unlike the others of group 1, this patient experienced occasional half-hour periods during which her environment appeared unreal and somewhat distorted. Her first electroencephalogram was taken June 12, 1945, at a time when obsessive thinking was pronounced. This record was abnormal because of the presence of excessive quantities of 3 to 5 per second waves in the frontal and parietal leads. Dextrose was administered orally before this test, and the response to hyperventilation was normal. A second electroencephalogram was made on October 19, at a time when she was free from all obsessive-compulsive symptoms but was experiencing the feelings of unreality before mentioned. This second record contained an excessive quantity of 5 to 7 per second waves and, in addition, showed an abnormal response to hyperventilation. Dextrose was not administered before this test. In order to evaluate the relationship between the administration of dextrose and the abnormal response to hyperventilation, the following experiment was performed on November 16. An electroencephalogram was taken with

3. Gibbs, F. A.; Gibbs, E. L., and Lennox, W. G.: Electroencephalographic Classification of Epileptic Patients and Control Subjects, Arch. Neurol. & Psychiat. **50**:111-128 (Aug.) 1943.

the patient fasting. The response to hyperventilation consisted of a big build-up of 5 to 7 per second activity of high amplitude, beginning at the end of the first minute and developing into 2 to 3 per second activity during the second minute. This duplicated the patterns obtained during the test run without dextrose taken on October 19. After the patient was tested while fasting (November 16), she was given orally 250 cc. of 50 per cent dextrose and retested fifteen minutes later. This time hyperventilation elicited 5 per second activity of average amplitude during the second minute. Toward the end of the second minute there were outbursts of 5 to 7 per second activity of high amplitude. These outbursts became more pronounced during the third minute, during which some 2 to 3 per second waves appeared; but 5 per second waves predominated. This response was considered comparable to that obtained in the first test with administration of dextrose, on June 12. The experiment was considered evidence that dextrose protected this patient against the appearance of electroencephalographic abnormalities educible with overbreathing.

Group 2.—The patients in this group also showed well marked obsessive-compulsive symptoms with varying admixtures of affective features. None showed any signs of a schizophrenic illness. Unlike group 1, all these patients showed disturbances in the organization of personality to the extent that they were classed as psychopathic personalities. The pathologic manifestations which led to classifying these patients as psychopathic could not be explained by the existence of any of the well defined types of psychoneurosis or psychosis but had to be considered as representing a fundamental psychopathologic disorder of the personality. In this group there were 10 patients, all of whom had abnormal electroencephalograms.

The concept of psychopathic personality as used in this paper needs elaboration. The functions of the personality may be considered pathologic when there is a disturbance in the organization of the personality or when personality features are exaggerated or underdeveloped. Considered from this point of view, psychopathic personalities may be classified according to the leading disturbances in personality functions. In disorders of personality organization, late or insufficient maturing may be the essential factor, as seen in the immature psychopathic type. In another type, i. e., the loosely organized psychopathic personality, the functions relating to the synthesis of the personality are disturbed. In both types one finds a lack of need and ability for the spontaneous adjustment of contradictory strivings and actions. With immaturity, which may be observed in adolescents, as well as adults, the person's attitude to life and his judgment in general do not correspond to his intelligence and chronologic age. Certain poorly organized personalities may show,

as one symptom, a rigidity along certain lines. Some psychopathic personalities have a basic, but usually unrecognized, intellectual disorder. In this type one finds vagueness of thinking caused by poor concept formation. Such vagueness may be seen in the setting of normal or superior intelligence. This type of psychopathic personality shows an increase in the thinking disorder under the influence of intense emotions. This phenomenon, in the past, has led psychiatrists to assume mistakenly that they were dealing with an early schizophrenic development when, for example, they encountered such a psychopathic personality, with obsessive-compulsive symptoms, marked anxiety and vagueness of thinking with poor concept formation. This type of intellectual disorder is often associated with general inadequacy of personality. Another type of psychopathic personality is characterized by low ethical and moral standards, with resulting social difficulties. Persons of this type exhibit irresponsibility of behavior with disregard of consequences, lack of persistence of emotional relationships and lack of emotional depth. Inability to profit from experience leads to repeated misdemeanors, such as stealing, lying, truancy and irresponsibility with regard to social and financial obligations.

Many other functions of personality may be disturbed in psychopathic persons, but the patients in group 2 of this study all showed an underlying psychopathic disorder of personality, characterized by one or more of the features discussed here, viz., loose organization of personality, immaturity, low ethical standards and general inadequacy with vague thinking. Simons and Diethelm,[2] in their study of psychopathic personalities, found that electroencephalographic abnormalities were confined to three types of psychopathic personalities, which they characterized as follows: (1) low ethical and moral standards; (2) loose organization of personality and (3) vague thinking and general inadequacy of personality. Thus, it can be seen that the types of psychopathic personality found in group 2 of the present study correspond closely to those found by Simons and Diethelm to be associated with abnormal electroencephalographic findings.

In their electroencephalograms, all the patients in group 2 showed slow waves of average or low amplitude, with frequencies of 3 to 5 or 5 to 7 per second. Two of the 10 records were considered borderline because of insufficient amounts of such slow waves. Two records had paroxysmal features. One of these had outbursts of 6 per second waves of high amplitude, while the other had outbursts of 5 per second waves of low voltage. Neither of the 2 patients with records showing paroxysmal features had any psychopathy that might be considered related to epilepsy.

Group 3.—This group includes 3 patients, all of whom showed well marked obsessive-compulsive symptoms but none of whom fell clearly into the categories of group 1 or group 2.

The first of these 3 patients, a woman aged 22, had a disorganizing illness of four years' duration, with definite schizophrenic symptoms, as well as obsessive thoughts and compulsive activity. The classification of her electroencephalogram was open to question because of drowsiness, but the pattern was probably normal.

The second patient, a 13 year old boy, had had a severe compulsion neurosis since the age of 3 years. His electroencephalogram was classified as abnormal because of the presence of 3 to 5 per second waves and a pathologic response to hyperventilation. It is known that the manifestations of disturbed personality organization may not make their appearance as early as the age of 13. Hence it was not possible to reach any final conclusion in regard to the underlying personality organization of this patient.

The third patient, a 16 year old youth, for six years had experienced a tic, characterized by head jerking with grunting. For three years before admission he had indulged in a compulsive ritual at bedtime, turning his pillow so that the open end was against the wall, with the idea that in some magic way this would make things go well the next day. His electroencephalogram was abnormal because of the presence of excessive quantities of 5 to 7 per second waves. The status of the personality organization could not be settled conclusively, and the presence of the severe tic introduced a complicating factor which made it impossible to evaluate etiologically the observed electroencephalographic abnormalities.

COMMENT AND CONCLUSIONS

The number of patients in this series was relatively small, but since each was thoroughly studied for an adequate period it is felt that certain tentative conclusions may be drawn.

1. Pathologic findings were present in the electroencephalograms of 13 out of 24 patients who presented obsessive-compulsive symptoms. There did not appear to be a connection between any special type of compulsive psychopathic disorder and the abnormal electroencephalographic findings. There was, however, a high degree of correlation between disturbances of the underlying personality organization and electroencephalographic abnormalities. All the patients with clearcut disturbances of personality organization, i. e., with psychopathic personalities, had abnormal electroencephalograms. Ten of the 11 patients who were considered to be well organized persons had normal electroencephalograms.

2. Abnormal electroencephalograms, which were found in all the patients with disturbances of personality organization, were characterized by the presence of excessive quantities of slow waves (3 to 7 per second). The consistent finding of slow activity in this series suggests that we

are dealing with the same type of neurophysiologic disturbance observed by Simons and Diethelm,[2] who, in their study of psychopathic personalities, reported:

> The majority of abnormal records were those containing sufficient 5 to 7 a second activity of low average amplitude in the frontal and parietal leads to be considered beyond the limits of normal.

3. If the conclusions drawn from these observations are valid, certain therapeutic implications follow. Any patient who shows electroencephalographic abnormalities of the type presented by these poorly organized psychopathic patients must be suspected at least of having a deficiency in the synthesizing functions of his personality: This point should be investigated further, utilizing both clinical observation and anamnestic data from outside sources whenever possible. In the treatment of a psychopathic patient with obsessive-compulsive symptoms, it has been our experience that more or less passive analytic technics will result in the disappearance of the obsessive-compulsive phenomena, but there remain the manifestations of psychopathic personality, which must be approached with a more active, synthesizing type of treatment. The electroencephalogram is a useful tool in giving an early lead to the presence of disturbances of personality organization, for these disturbances are not always obvious during early contacts with the patient.

4. The present study gives evidence that certain types of psychopathic personality, described by Simons and Diethelm,[2] are associated with electroencephalographic abnormalities, whether these disturbances of personality organization appear as the leading clinical features or occur in cases in which obsessive-compulsive symptoms dominate the clinical picture.

Recognition that a considerable number of patients with obsessive-compulsive symptoms are psychopathic is not new. Meige and Feindel [4] in their monograph, published in 1907, cited the views of a number of earlier French psychiatrists in regard to the personality makeup of patients with tics, obsessions, compulsions and phobias. Charcot (1888) remarked on the presence of certain signs or psychic stigmas of degeneration, or instability, as he preferred to say. Ballet called these patients "superior degenerates," or "unstable," and remarked on the inequality of their mental development, stating that "brilliance of memory or conversational gifts may be counteracted by absolute lack of judgment; solidity of intellect may be neutralized by more or less complete absence of moral sense." Itard (1825) noted "mental infantilism, evidenced by inconsequence of ideas and fickleness of mind, reminiscent of early youth and unaltered with the attainment of years

4. Meige, H., and Feindel, E.: Tics and Their Treatment, translated and edited by S. A. K. Wilson, London, Sidney Appleton, 1907.

of discretion." Magnan said of these "superior degenerates" that "clinical observation reveals functional disorders so distinct and so invariable that it is impossible that they should not be the outcome of some pathologic modification of the organism." It seems fitting to conclude with the comment that our observations on neurophysiologic disturbances in a group of psychopathic patients with obsessive-compulsive symptoms merely confirm the statement made by Magnan in the latter part of the nineteenth century.

Payne Whitney Psychiatric Clinic, New York Hospital.

EFFECTS OF PITRESSIN HYDRATION ON THE ELECTROENCEPHALOGRAM

Paroxysmal Slow Activity in Nonepileptic Patients with Previous Drug Addiction

ABRAHAM WIKLER, M.D.
Surgeon (R), United States Public Health Service
LEXINGTON, KY.

ALTHOUGH hydration by forcing of fluids and the use of pitressin has long been employed to precipitate epileptic seizures for diagnostic purposes in persons suspected of having idiopathic epilepsy,[1] no study has been made of the electroencephalographic changes produced by this procedure, either in normal or in epileptic subjects. A single injection of pitressin has been reported to have no effect on the electroencephalogram,[2] but no data have been found on the effects of water intoxication except for the statement by Allen [3] that some experiments of this type on dogs had been attempted.

The present study was undertaken in an attempt to solve a clinical problem. A patient at the United States Public Health Service Hospital was referred for electroencephalographic study because he exhibited periodic episodes of antisocial behavior. A diagnosis of psychopathic personality had been made, but it was desired to rule out epilepsy. A routine electroencephalogram was essentially normal. A pitressin hydration test was then made with a view to provoking a fit, antisocial behavior or "epileptiform" changes in the electroencephalogram. Neither a fit nor antisocial behavior occurred during this procedure, but paroxysmal slow activity did appear in the electroencephalogram. This was difficult to interpret because of the lack of control data in the literature, and therefore further investigations were made.

MATERIALS AND METHODS

The subjects for these experiments were 14 male patients at the United States Public Health Service Hospital who were undergoing treatment for addiction

From the United States Public Health Service Hospital.

1. McQuarrie, I., and Peeler, D. B.: The Effects of Sustained Pituitary antidiuresis and Forced Water Drinking in Epileptic Children: A Diagnostic and Etiologic Study, J. Clin. Investigation **10**:915, 1931. Hilger, D. W.; Mueller, A. R., and Freed, A. E.: The Pitressin Hydration Test in the Diagnosis of Idiopathic Epilepsy, Mil. Surgeon **91**:309, 1942.

2. Gibbs, F. A.; Gibbs, E. L., and Lennox, W. G.: Effect on the Electroencephalogram of Certain Drugs Which Influence Nervous Activity, Arch. Int. Med. **60**:154 (July) 1937.

3. Allen, F. F.: Spontaneous and Induced Epileptiform Attacks in Dogs, in Relation to Fluid Balance and Kidney Function, Am. J. Psychiat. **102**:67, 1945.

to opiates while serving sentences for violation of the Harrison Narcotic Act and who volunteered for this test. All these subjects had been in the institution six months or more and had not used opiates habitually for at least that length of time. Their ages varied from 32 to 46, with an average of 37.1. None gave a history of epilepsy, and in no case had a seizure been recorded since the patient's admission to the institution. All were in good health. For 7 patients a diagnosis of psychopathic personality was made on admission.

Electroencephalograms were made before and after pitressin hydration. Silver–silver chloride cup electrodes were applied to the scalp, and bipolar recordings were made from the frontal, precentral, parietal and occipital regions. The electroencephalograph was a four channel, capacity-coupled, amplifier and oscillographic apparatus with photographic recording on bromide paper. During the recording the patient lay quietly on a comfortable bed in an electrically shielded, soundproofed, air-cooled room. An observer was always present to note movement and to make sure the patient was not asleep. Records were taken before, during and after hyperventilation.

Each record was analyzed as follows: A representative thirty second sample was selected, and all waves over 5 microvolts in amplitude were measured and counted. Paroxysmal activity was not included in the strip. The mean alpha frequency was calculated by averaging all frequencies from 8 to 13 per second, and the percentage of alpha activity was determined by calculating the time occupied by such frequencies during a thirty second recording. A frequency spectrum was then plotted. The limits of individual variation from day to day were determined on several records, and, with this method of analysis, the variation in alpha frequency was found to be not more than 0.5 cycle per second, and that in percentage of alpha activity, 12 per cent.

The method of hydration varied to a considerable extent because of differences in the ability of the subjects to tolerate this procedure. In the first few experiments, pitressin was injected hypodermically every hour for seven hours (in doses of 0.3, 0.4, 0.5, 0.5, 0.5, 0.5, 0.5 cc.), and the patient drank 500 cc. of water every hour for eleven hours. Some patients were able to tolerate this, but others suffered from vomiting and abdominal cramps. The procedure was then altered by giving smaller doses of pitressin hourly for eight hours (0.2, 0.3, 0.3, 0.3, 0.3, 0.3, 0.3, 0.3 cc.) and administering 1,000 cc. of 5 per cent dextrose in distilled water intravenously every two hours until a total of 5,000 cc. had been given during the eight hour test period. Some minor modifications were made in the dosage in individual cases.

The patients were admitted to the research ward in the morning, and preliminary physical examinations and records of pulse, temperature, blood pressure, respiration and weight were made. An electroencephalogram was made in the afternoon. Pitressin hydration was begun early the next morning, and the patient was weighed at frequent intervals. Another electroencephalogram was made the same afternoon, after maximum hydration had been achieved. The patients were closely observed, and records of blood pressure, pulse, respiration and temperature were made every four hours during the period of hydration. A regular diet was prescribed, but coffee, tea and soup were excluded.

RESULTS

Clinical Observations.—Some of the patients were fairly comfortable during these procedures, but most of them had some degree of discomfort, chiefly nausea, abdominal cramps and occasional vomiting.

Considerable puffiness of the face appeared in a few patients. In none did alarming reactions of circulatory nature appear, and there were no significant changes in pulse rate or blood pressure. No epileptic seizures of any kind were precipitated. It was found that the smaller doses of pitressin (0.3 cc.) were just as effective in inhibiting diuresis as larger amounts and produced less discomfort. On the morning following pitressin hydration voluminous diuresis took place, and the patient's weight returned rapidly to or slightly below the control level.

Electroencephalographic Observations.—The data are summarized in the table. The average gain in weight at the end of hydration was

Effects of Pitressin Hydration on the Electroencephalogram

Subject No.	Total Pitressin, Cc.	Per Cent Gain in Body Weight	Alpha Frequency			Alpha Percentage			Comment
			Before	After	Difference	Before	After	Difference	
1	3.4	5.3	9.9	10.1	+0.2	71.0	73.7	+ 2.7	Shift to slow side and paroxysmal delta activity after hydration
2	3.4	5.0	10.2	9.8	—0.4	83.5	82.1	— 1.4	
3	3.2	4.5	11.1	10.6	—0.5	47.3	40.0	— 7.3	
4	3.2	2.7	10.7	10.5	—0.2	42.3	63.3	+21.0	Shift to slow side after hydration
5	3.0	2.6	11.5	10.9	—0.6	42.7	42.2	— 0.5	
6	3.0	5.1	11.6	11.4	—0.2	57.4	67.8	+10.4	Shift to slow side and paroxysmal delta activity after hydration
7	3.2	1.8	9.9	10.0	+0.1	87.1	90.8	+ 3.7	
8	2.6	3.2	10.3	10.0	—0.3	76.2	67.7	— 8.5	Shift to slow side after hydration
9	2.5	7.3	10.3	9.7	—0.6	74.3	58.9	—15.4	Shift to slow side and paroxysmal delta activity after hydration
10	1.3	4.3	11.5	11.5	0.0	22.6	22.9	+ 0.3	Paroxysmal delta activity after hydration
11	1.3	5.3	11.1	10.5	—0.6	42.9	63.9	+21.0	Shift to slow side and paroxysmal delta activity after hydration
12	1.3	4.4	10.9	10.7	—0.2	63.3	41.2	—22.1	Paroxysmal delta activity after hydration
13	1.7	5.3	10.4	10.4	0.0	67.0	61.2	— 5.8	
14	1.0	3.9	11.1	10.6	—0.5	60.8	46.9	—13.9	Shift to slow side and paroxysmal delta activity after hydration

3 Kg., or 4.1 per cent of body weight. In 3 of the subjects the mean alpha frequency was lowered 0.6 cycle per second, but in the remainder the changes in alpha frequency, although mostly in the direction of slowing, were within the range of daily variation. In half the patients the frequency spectrum showed a definite shift toward the slow side (fig. 1). In the remainder no definite shift could be observed. In no case was there an unequivocal shift toward the fast side of the spectrum.

The most striking change, however, was the appearance of bursts of slow activity (6 cycles per second) of moderately high amplitude in 7 of the 14 records after hydration (fig. 2). All but 1 of the control records were essentially normal and contained no paroxysmal slow activity, either before or after hyperventilation. In the one record

a scant amount of paroxysmal 6 per second rhythm was present, and this activity was greatly increased after hydration. In those records which showed paroxysmal 6 per second rhythms, such activity appeared in short bursts of 8 to 15 waves two to six times during the entire run, which was usually about three or four minutes. The incidence of paroxysmal slow activity was not entirely the same as that of shift in the frequency spectrum to the slow side. In 2 records there was a shift but no paroxysmal slow activity, and in 2 the latter was present but there was no shift in the spectrum. There was no correlation between the incidence of paroxysmal slow activity and the degree of hydration or the total amount of pitressin injected. Nor was there a correlation between the admission diagnosis of psychopathic personality and shift in frequency spectrum or incidence of slow activity. Such changes in the electroencephalogram after pitressin hydration were present in 50 per cent of patients with diagnoses of psychopathic personality and in 50 per cent of the others. Consciousness was not grossly disturbed

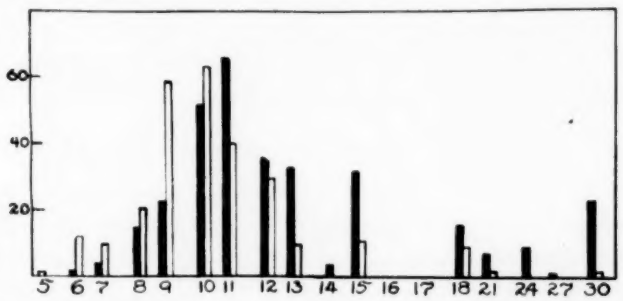

Fig. 1 (case 1).—Effects of pitressin hydration on the frequency spectrum of the electroencephalogram. The solid bars indicate values before, and the outline bars values after, pitressin hydration. On the abscissa are plotted frequencies in terms of cycles per second; on the ordinate, the number of such frequencies in a thirty second record. Note the shift to the slow side after hydration.

during the electroencephalographic recording so far as could be determined by the observer in the electroencephalographic chamber.

COMMENT

Although none of the patients gave a history or showed clinical evidence of epilepsy, the electroencephalograms obtained on half the subjects after pitressin hydration could be termed "epileptoid" because of the presence of paroxysmal slow activity. Furthermore, it is noted that this change occurred in only half the subjects and was independent of the degree of hydration. This suggests that the appearance of "epileptoid" changes in the electroencephalogram depends on individual susceptibility. It should be emphasized here that the persons subjected to this test were not truly representative of a "normal" group, since all

had previously been drug addicts and recent studies at this institution have shown that the great majority of the drug addicts fall into either the psychopathic or the psychoneurotic group.[4]

The findings provide a partial answer to the clinical problem which gave rise to this study. It is evident that the appearance of paroxysmal slow activity in the electroencephalogram after pitressin hydration cannot be considered indicative of epilepsy in the clinical sense of the

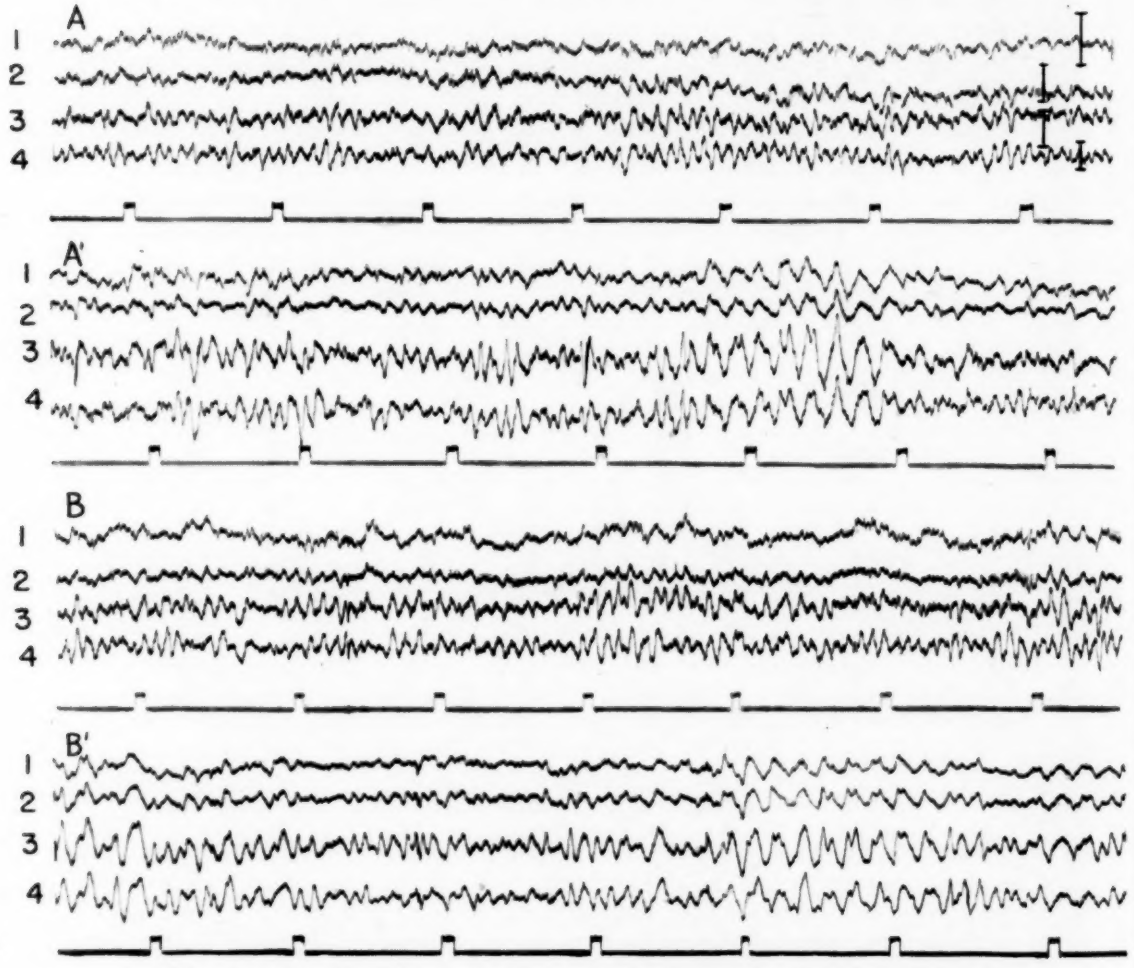

Fig. 2 (case 6).—Effects of pitressin hydration on the electroencephalogram (bipolar recording from the frontal (*1*), precentral (*2*), parietal (*3*) and occipital (*4*) leads; calibration 50 microvolts; time in seconds). *A* and *B* are control records made before and after hyperventilation, respectively; *A'* and *B'*, records obtained before and after hyperventilation after pitressin hydration. Note the paroxysmal 6 per second activity after hydration.

4. Aldrich, C. K., and Ruble, D. C.: Studies on the Personalities of Drug Addicts, to be published.

term. However, it does suggest the possibility that the physiologic mechanism which underlies the production of clinical seizures by this method is also operant in certain susceptible nonepileptic persons and that, essentially, quantitative threshold differences determine whether or not, in any given case, clinical seizures will be precipitated. It would be illuminating, in this connection, to compare the group observed in this investigation with "normal" subjects and with persons known to have epilepsy with special reference to the incidence of paroxysmal slow activity in the electroencephalogram after pitressin hydration. However, such studies have not yet been made.

SUMMARY AND CONCLUSIONS

The electroencephalograms of 14 nonepileptic men with previous drug addiction were studied before and after pitressin hydration. No clinical seizures were induced by this procedure.

The alpha frequency showed a tendency to slowing after hydration, but in only 3 instances was the degree of change greater than that which could be expected from day to day variation. There was no significant change in the percentage of alpha activity.

In half the records there was shift to the slow side of the frequency spectrum.

In half the records paroxysmal slow activity of moderately high amplitude appeared after hydration.

There was some correlation between the appearance of paroxysmal slow activity and the shift of the frequency spectrum to the slow side, but no correlation with the degree of hydration or the amount of pitressin administered.

The possible significance of these observations in their relation to idiopathic epilepsy is discussed.

United States Public Health Service Hospital.

OBJECTIVE METHOD FOR DISTINGUISHING SLEEP FROM THE HYPNOTIC TRANCE

JOHN B. DYNES, M.D.
BOSTON

ALTHOUGH most persons spend approximately one third of their lives sleeping, and although considerable time and study have been expended in the elucidation of this phenomenon, little is known about it. It is recognized that certain phenomena occur during sleep[1]: There is a generalized muscular relaxation which roughly parallels the depths of sleep; the temperature of the body falls; tendon reflexes tend to diminish and may disappear; breathing becomes periodic, and there is a slight acidosis, with increase of carbon dioxide in the blood. Contrary to earlier theories regarding the blood supply of the brain in the sleeping state, it is now fairly well established that there is no anemia of the brain during sleep. However, until the advent of the electroencephalograph there was no instrument or objective measuring device which would indicate the sleeping state with any degree of certainty. The characteristic changes which occur in the electroencephalograms of sleeping persons have been well demonstrated in the work of Davis[2] and Loomis[3] and their associates. Figure 1[4] illustrates the electroencephalographic patterns occurring at each of the various levels of sleep. Lines 1 and 12 of this tracing illustrate the electroencephalographic tracings in the normal waking state, and lines 2 to 11, inclusive, those at the various levels of sleep. Line 2 shows the pattern during very light sleep, with general low voltage and flattening of the tracing. Line 5 is typical of deep sleep, with the appearance of high voltage, slow waves. Although it must be confessed that the nature of sleep is

From the Department of Neuropsychiatry, Lahey Clinic.

1. Kleitman, N.: Sleep and Wakefulness as Alternate Phases in the Cycle of Existence, Chicago, University of Chicago Press, 1939.

2. Davis, H.; Davis, P. A.; Loomis, A.; Harvey, E. N., and Hobart, G.: Human Brain Potentials During the Onset of Sleep, J. Neurophysiol. **1**:24-38, 1938. Davis, P. A.: Effects of Sound Stimulation on the Waking Human Brain, ibid. **1**:494-499, 1939.

3. Loomis, A. L.; Harvey, E. N., and Hobart, G. A.: Disturbance-Patterns in Sleep, J. Neurophysiol. **1**:413-430, 1938.

4. Dynes, J. B.: Narcolepsy and Cataplexy, Lahey Clin. Bull. **2**:83-90, 1941.

poorly understood, at the same time, with an objective measure of the phenomena of sleep, such as that offered by the electroencephalogram, there is hope of further elucidating the fundamental nature of sleep and, also, of distinguishing certain other conditions from sleep. This

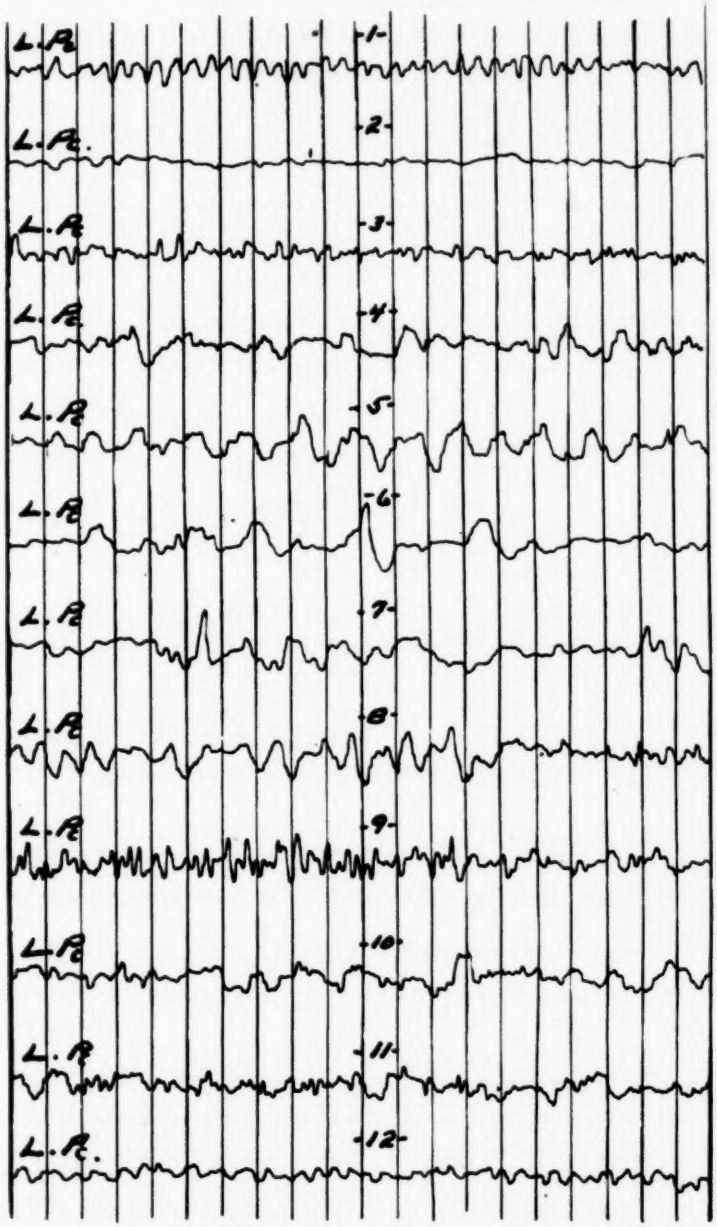

Fig. 1.—Electroencephalograms taken during the normal waking state (lines *1* and *12*) and various levels of normal sleep (lines *2* to *11*, inclusive). Line *2* shows very light sleep, and line *5*, deep sleep.

paper deals primarily with the objective evidence, as recorded by the electroencephalograph, in the distinction between sleep and the hypnotic trance.

Hypnosis and sleep have been considered by many investigators as related states, and the similarity between these two states has been mentioned in all previous neurophysiologic studies and theories relating to this subject. Hypnosis has been spoken of as "an artificial sleep," or as "a sleep-like state." Few hypnotists induce a trance without referring to sleep directly or indirectly. Pavlov [5] expressed the belief

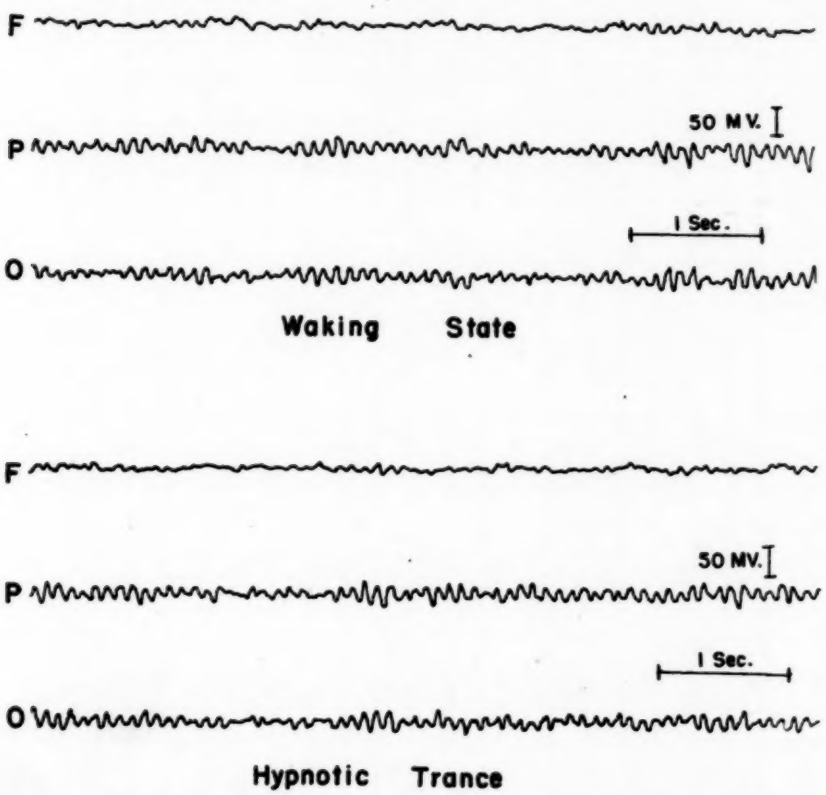

Fig. 2.—Electroencephalograms taken during the waking state and during a hypnotic trance.

that sleep and hypnosis were related and postulated a state of inhibition of the brain which influenced motor activity primarily. Schilder and Kauders [6] stated that the altered state of consciousness in hypnosis is

5. Pavlov, I. P.: Inhibition, Hypnosis and Sleep, Brit. M. J. **2**:256-257, 1923.

6. Schilder, P., and Kauders, O.: Hypnosis, translated by S. Rothenberg. Nervous and Mental Disease Monograph Series no. 46, New York, Nervous and Mental Disease Publishing Company, 1927, p. 118.

in some way related to stimulation of the so-called sleep center in the region of the hypothalamus and the third ventricle. Kubie and Margolin [7] expressed the opinion that the induction of hypnosis is a condition of partial sleep and that the monotony of sensory stimulation and the immobility of the subject are the chief factors in bringing about the hypnotic trance. Salter,[8] in his theory, stated that hypnosis is a type of conditioned reflex and inferred that hypnosis is a variant of sleep.

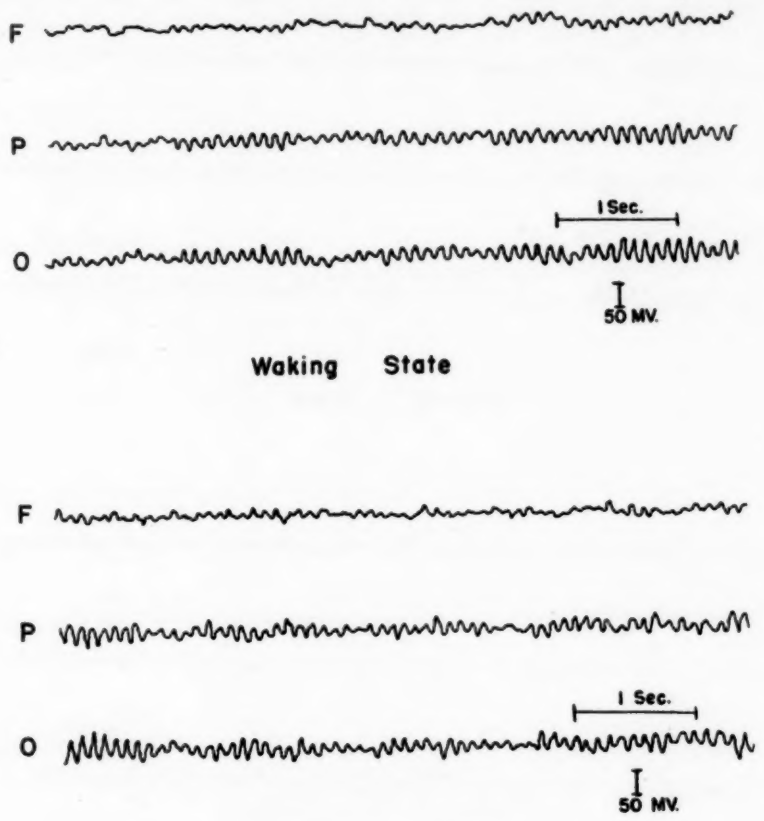

Fig. 3.—Electroencephalograms taken during the waking state and during a hypnotic trance.

Although the electroencephalogram does give an objective measure or indicator of the phenomenon of sleep, there as yet exists no objective measure or indicator of the hypnotic trance. It is true that there have

7. Kubie, L. S., and Margolin, S.: The Process of Hypnotism and the Nature of the Hypnotic State, Am. J. Psychiat. **100**:611-622, 1944.

8. Salter, A.: What Is Hypnosis: Studies in Auto and Hetero Conditioning. New York, Richard R. Smith, 1944.

been those who claimed that a hypnotic trance might be induced without reference to sleep[9]; it is also true that the so-called production of hypnotic phenomena has been observed in the waking state. The great variety of sensory and motor phenomena observed in association with conversion hysteria in the "waking state" may also be reproduced in a hypnotic trance. However, no one had presented any good objective evidence that the phenomena of sleep and the phenomena of the hypnotic trance were of a different order until Loomis,[10] in 1936, reported a

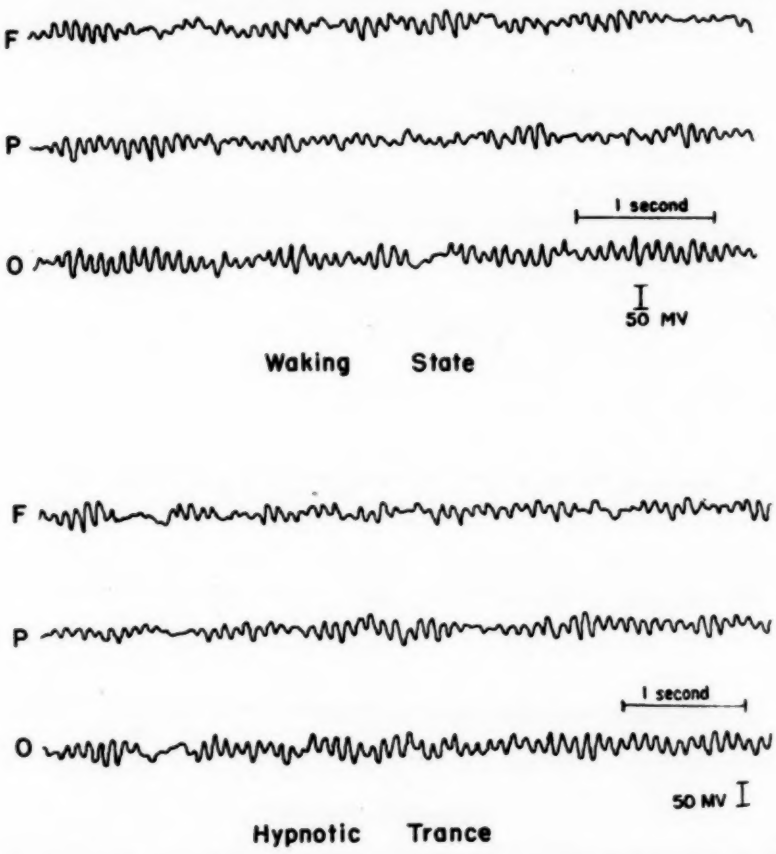

Fig. 4.—Electroencephalograms taken during the waking state and during a hypnotic trance.

single instance in which the electroencephalogram of a patient in the hypnotic trance showed no fundamental change from the electro-

9. Wells, W. R.: Experiments in Waking Hypnosis for Instructional Purposes, J. Abnorm. & Social Psychol. **18**:389-404, 1924.

10. Loomis, A. L.; Harvey, E. N., and Hobart, G.: Brain Potentials During Hypnosis, Science **83**:239-241, 1936.

encephalogram taken during the so-called waking state. No electroencephalographic tracings were presented, and no one, to my knowledge, has confirmed or substantiated this report. Brenman and Gill,[11] in their recent review of hypnotherapy, concluded that the use of cortical electrical activity as a criterion has yielded contradictory results and cited the work of Loomis and associates [10] and Lundholm and Löwenbach.[12] A review of the article by the latter authors does show a

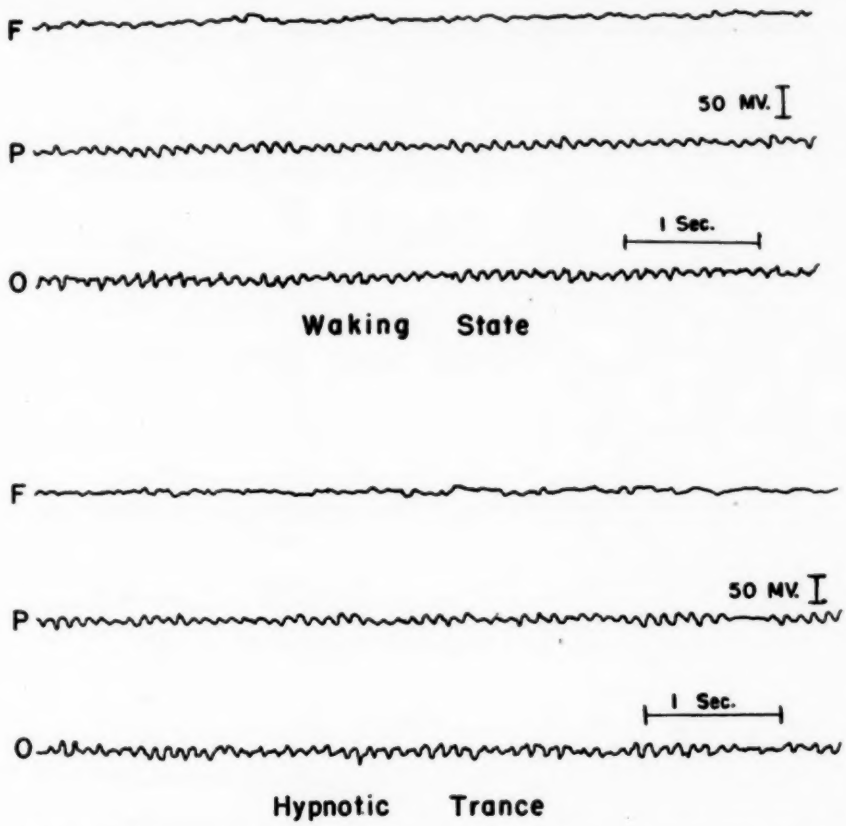

Fig. 5.—Electroencephalograms taken during the waking state and during a hypnotic trance.

failure to confirm by means of the electroencephalogram certain phenomena of the hypnotic trance, but there was no disagreement with the earlier report by Loomis that no difference exists between the

11. Brenman, M., and Gill, M. M.: Hypnotherapy, Review Series, New York, Josiah Macy Foundation, 1944, vol. 2, no. 3.

12. Lundholm, H., and Löwenbach, H., Jr.: Hypnosis and the Alpha Activity of the Electroencephalogram, Character & Person. **11**:145-149, 1942.

electroencephalographic tracing of the waking person and that of a person in an hypnotic trance, as Lundholm and Löwenbach did not call attention to this important observation.

The accompanying electroencephalographic tracings (figs. 2, 3, 4, 5 and 6), recorded on 5 different patients, illustrate the waking state and the hypnotic trance in each subject. The apparatus used was a three channel, Grass electroencephalograph, with leads taken from the frontal,

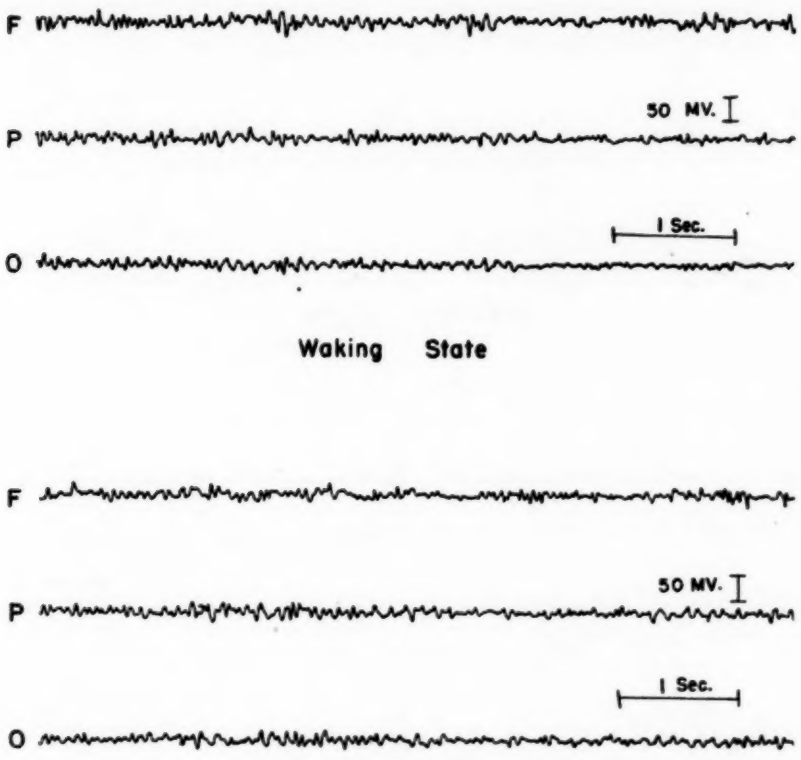

Fig. 6.—Electroencephalograms taken during the waking state and during a hypnotic trance.

parietal and occipital regions. Each subject was capable of being placed in a deep hypnotic trance. The criteria used to indicate a deep trance were complete amnesia for events happening in the hypnotic trance, anesthesia to painful stimuli and the ability to carry out posthypnotic suggestions. One patient had been hypnotized repeatedly and had been conditioned so that he would pass into a trance more or less instan-

taneously on the giving of a signal. The signal in this particular instance was the snapping of the hypnotist's fingers. Figure 7 illustrates two electroencephalographic tracings taken at times when an instantaneous trance was induced. There is no indication that cortical electrical activity, as shown in the electroencephalogram, was altered, either at the time of induction of the trance or later, when the patient was in a deep trance. There is no evidence that the cortical electrical activity as recorded by the electroencephalogram during the hypnotic

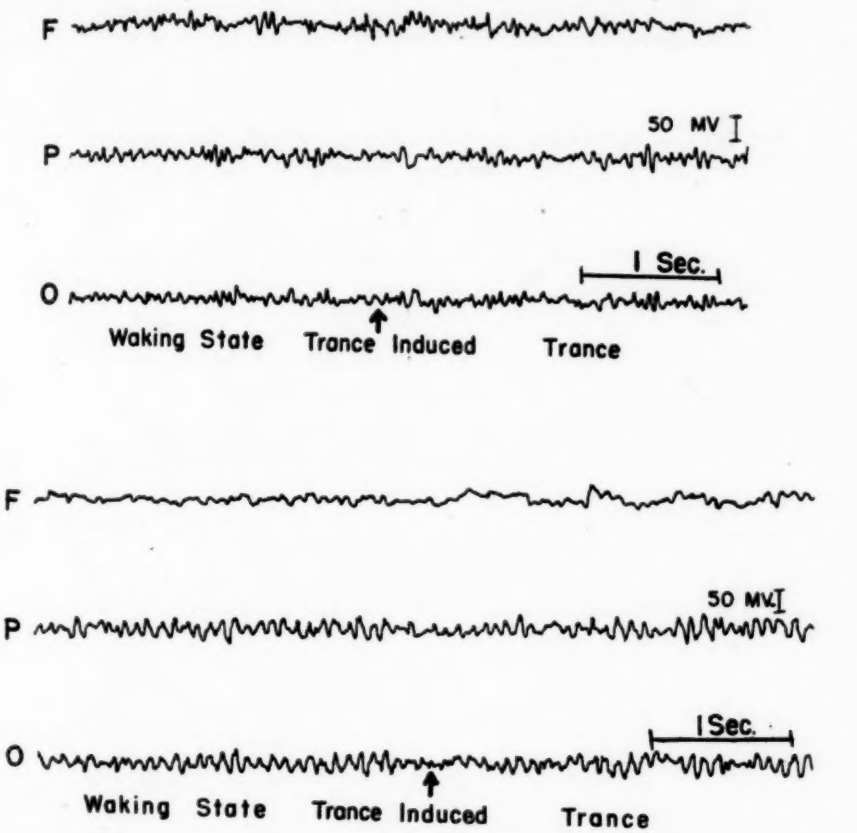

Fig. 7.—Electroencephalogram taken at the time an instantaneous hypnotic state was induced.

trance resembled the cortical electrical activity as seen in a sleeping person (figs. 1 and 8). Figure 8 illustrates the electroencephalograms taken in the waking state, the hypnotic trance and a light sleeping state in the same patient. It is apparent that the sleeping state, as seen in figures 1 and 8, gives rise to an entirely different type of electrical activity than does either the waking state or the hypnotic trance.

SUMMARY

It appears from these electroencephalographic tracings that there was no distinctive difference between the cortical electrical activity at the time the hypnotic trance was induced, or during the established hypnotic trance, and that of the normal waking state, and, further, that

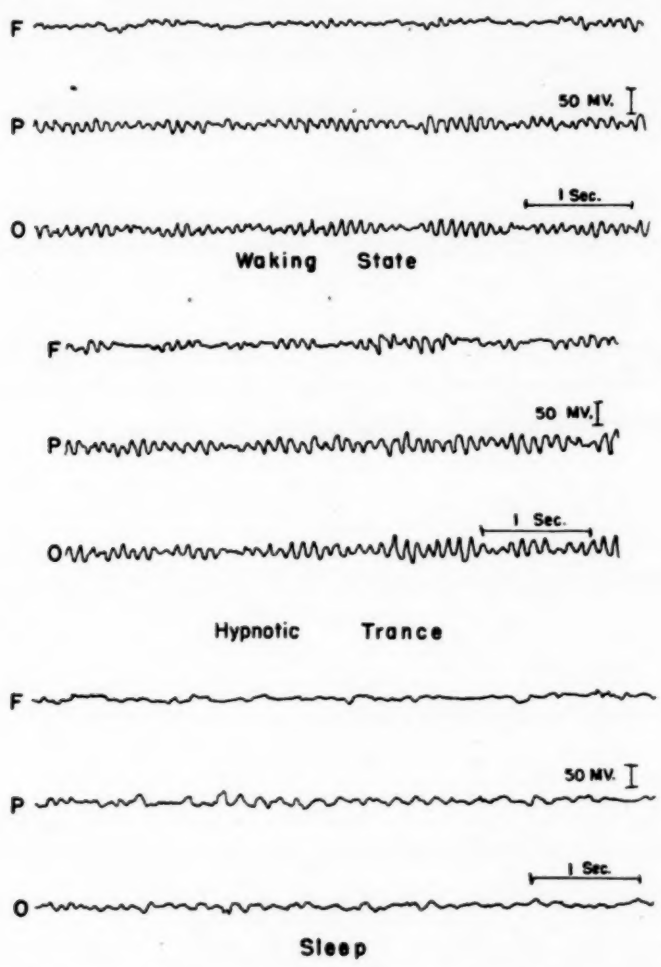

Fig. 8.—Electroencephalograms taken during the waking state, a hypnotic trance and a light sleeping state.

the cortical electrical activity recorded from the brain of a person in a hypnotic trance shows no resemblance to the electroencephalographic tracings taken from the brain of a sleeping person. The objective evidence presented here confirms the opinions of investigators who have claimed that hypnosis is not a sleep variant. Just what hypnosis is has

not been determined objectively, although it can be said that there is no definite difference between the cortical electrical activity, as recorded electroencephalographically, of a person in a deep hypnotic trance and that of the same person in the normal waking state.

605 Commonwealth Avenue.

CIRCULATION OF THE BRAIN AND FACE

Determinations of Oxygen and Sugar in Arterial and in Internal and External Jugular Venous Blood

JULIUS LOMAN, M.D.
AND
ABRAHAM MYERSON, M.D.
BOSTON

THE VESSELS of the brain are much more resistant to changes in caliber than vessels elsewhere in the body. Forbes and Cobb [1] observed that when the cervical sympathetic nerve is stimulated, arteries in the skin constrict ten times as much as those in the pia. Pool, Nason and Forbes [2] found that the vessels of the dura are almost eight times as active as the arteries of the pia. Schmidt and Hendrix [3] observed that the vessels of the parietal cortex are much less responsive to vasomotor drugs than the vessels of the tongue and of the mylohyoid muscle. Of all the cerebral vasodilators, carbon dioxide is the most consistently effective.[4] Vasodilators, such as histamine, acetylcholine and acetyl-beta-methylcholine, which have a pronounced dilating action on the extracranial vessels, are either comparatively ineffective or irregular in their influence on the intracranial vessels.[3] Nicotinic acid, another strong extracranial vasodilator, has a comparatively mild effect on the intracranial circulation.[5]

The purpose of the present study was to compare the oxygen and sugar contents of the arterial and internal and external jugular venous blood as an indirect index of the blood flow in the brain and face.

From the Division of Psychiatric Research, Boston State Hospital.

This study was aided by a grant from the Commonwealth of Massachusetts.

1. Forbes, H. S., and Cobb, S.: Vasomotor Control of Cerebral Vessels, A. Research Nerv. & Ment. Dis., Proc. (1937) **18**:201, 1938.

2. Pool, J. L.; Nason, G. I., and Forbes, H. S.: Cerebral Circulation: XXXIII. The Effect of Nerve Stimulation and Various Drugs on the Vessels of the Dura Mater, Arch. Neurol. & Psychiat. **32**:1202 (Dec.) 1934.

3. Schmidt, C. F., and Hendrix, J. P.: The Action of Chemical Substances on Cerebral Blood-Vessels, A. Research Nerv. & Ment. Dis., Proc. (1937) **18**:229, 1938.

4. Wolff, H. G., and Lennox, W. G.: Cerebral Circulation: XII. The Effect on the Pial Vessels of Variations in the Oxygen and Carbon Dioxide Content of the Blood, Arch. Neurol. & Psychiat. **23**:1097 (June) 1930. Schmidt and Hendrix.[3]

5. Loman, J.; Rinkel, M., and Myerson, A.: The Intracranial and Peripheral Vascular Effects of Nicotinic Acid, Am. J. M. Sc. **202**:211, 1941.

MATERIAL AND METHODS

Quiet, cooperative patients with dementia precox were the subjects of the study. They lay quietly for one-half hour before the experiments were begun. Blood was withdrawn simultaneously from the brachial artery and the internal and external jugular veins. The external jugular vein is fairly readily entered as it courses across the sternocleidomastoid muscle. This vein is made to stand out conspicuously in most cases by compressing the structures above the clavicle. A long-beveled,

TABLE 1.—*Oxygen Content of the Arterial and of External and Internal Jugular Venous Blood of Forty-Two Subjects with Dementia Precox*

Patient	Oxygen Content, Vol. %			Differences in Oxygen Content, Vol.%	
	Arterial Blood	External Jugular Venous Blood	Internal Jugular Venous Blood	Arterial–External Jugular Venous Blood	Arterial–Internal Jugular Venous Blood
J. C.	20.3	17.8	10.7	2.5	9.6
W. D.	16.9	14.5	12.8	2.4	4.1
C. C.	15.7	13.8	9.2	1.9	6.5
B. O.	14.2	12.6	7.2	1.6	7.0
F. K.	15.7	11.2	10.5	4.5	5.2
P. S.	18.4	14.6	13.9	3.8	4.5
R. M.	17.5	16.5	10.6	1.0	6.9
F. F.	17.7	16.7	11.0	1.0	5.7
W. M.	15.3	14.3	9.6	1.0	5.7
W. B.	15.6	15.2	11.2	0.4	4.4
T. M.	14.3	12.9	9.3	1.4	5.0
L. H.	18.7	17.5	12.9	1.2	5.8
J. S.	17.7	15.3	12.2	2.4	5.5
P. G.	19.0	18.1	11.3	0.9	7.7
G. L.	18.0	15.5	11.2	2.5	6.8
E. L.	20.4	17.8	11.4	2.6	9.0
C. S.	17.4	16.4	11.7	1.0	5.7
A. K.	16.7	15.0	13.3	1.7	3.4
E. L.	20.0	16.9	11.9	3.1	8.1
O. S.	16.9	15.2	12.9	1.7	7.0
A. K.	16.5	13.9	11.0	2.6	4.5
H. B.	17.2	15.5	9.5	1.7	7.7
J. S.	18.5	16.7	13.1	0.8	5.4
J. C.	17.1	15.9	9.0	1.2	8.1
W. D.	14.3	12.9	4.1	1.4	10.2
E. L.	19.5	16.6	11.9	2.9	7.6
W. L.	19.5	18.3	11.9	1.2	7.6
W. D.	13.1	10.9	6.0	2.2	7.1
H. B.	17.1	13.0	10.3	4.1	6.8
J. C.	17.2	14.3	9.8	2.9	7.4
W. M.	18.1	15.4	11.0	2.7	7.1
P. S.	18.5	13.7	11.5	4.8	7.0
F. F.	18.0	16.6	10.4	1.4	7.6
W. B.	17.2	14.8	11.0	2.4	6.2
W. L.	16.7	16.0	9.5	0.7	7.2
W. M.	17.6	16.1	8.4	1.5	9.2
F. B.	17.5	16.3	11.2	1.2	6.3
H. L.	19.6	16.7	11.1	2.9	8.5
G. L.	16.8	16.4	13.9	0.4	2.9
J. S.	18.5	17.6	10.8	0.9	7.7
W. M.	15.7	14.0	10.5	1.7	5.2
J. D.	17.5	16.3	12.0	1.2	5.5
Average	17.3	15.4	10.8	1.9	6.6

very sharp needle facilitates the puncture of the external jugular vein, since the vessel tends to collapse readily. The oxygen determinations were carried out by the Van Slyke method and the sugar determinations by the Folin-Wu method.

RESULTS

Table 1 shows the oxygen contents of the brachial artery and the internal and external jugular veins for 42 patients. The values for the

internal jugular vein were found to be very close to those observed by Gibbs, Lennox, Nims and Gibbs,[6] who compared the various chemical constituents of this vessel in 50 normal subjects. In most instances the blood withdrawn from the external jugular vein had the appearance of arterial blood. Its color was readily explained by its high oxygen content, a value which was usually much closer to that of the arterial blood than to that of the internal jugular venous blood. The differences in oxygen content between the arterial and the external jugular venous blood varied from 0.4 to 4.8 volumes per cent, with an average difference of 1.9 volumes per cent, in contrast to the differences between the arterial and the internal jugular venous blood, which varied from 2.9 to 10.2 volumes per cent, with an average difference

TABLE 2.—*Oxygen and Sugar Contents of Arterial and of External and Internal Jugular Venous Blood* *

	Oxygen Content, Vol. %					Sugar Content, Mg./100 Cc. Blood				
Patient	A.	E. J.	I. J.	A.–E. J.	A.–I. J.	A.	E. J.	I. J.	A.–E. J.	A.–I. J.
W. D.	13.1	10.9	6.0	2.2	7.1	96	96	86	0	10
H. B.	17.1	13.0	10.3	4.1	6.8	98	98	86	0	12
F. F.	18.0	16.6	10.4	1.4	7.6	101	99	87	2	14
W. B.	17.2	14.8	11.0	2.4	6.2	85	86	79	+1	6
W. L.	16.7	16.0	9.5	0.7	7.2	97	89	79	8	18
W. M.	17.6	16.1	8.4	1.5	9.2	100	97	92	3	8
G. L.	16.8	16.4	13.9	0.4	2.9	86	86	81	0	5
J. S.	18.5	17.6	10.8	0.9	7.7	81	80	72	1	9
W. M.	15.7	14.0	10.5	1.7	5.2	100	95	89	5	11
F. L.	17.5	13.2	....	4.3	...	79	79	70	0	9
Average	16.8	14.9	9.1	2.0	6.0	92	91	82	2	11

* In this table, A. indicates arterial blood; E. J., external jugular venous blood; I. J., internal jugular venous blood; A.-E. J., arterial-external jugular venous difference, and A.-I. J., arterial-internal jugular venous difference.

of 6.6 volumes per cent. There was found to be no correlation between the color (redness or paleness) of the face and the percentage of oxygen uptake by the face.

In another group, of 10 subjects, the differences in sugar and oxygen content between the arterial and the external jugular venous blood and the arterial and the internal jugular venous blood were compared. As with the differences in oxygen content, only a relatively small amount of sugar was removed from the arterial blood as it passed through the face as compared with the amount that was removed from the arterial blood as it passed through the brain (table 2).

COMMENT

Approximately three times as much oxygen disappears from the blood in its passage through the brain as from the blood in its passage

6. Gibbs, E. L.; Lennox, W. G.; Nims, L. F., and Gibbs, F. A.: Arterial and Cerebral Venous Blood: Arterial-Venous Differences in Man, J. Biol. Chem. **144**: 325, 1942.

through the face. An insufficient number of cases were studied for comparison of the arterial-venous differences in sugar content between the two organs, although very marked differences also occur with reference to this metabolite. The low uptake of oxygen by the face and scalp can be explained either by the low metabolic requirements of these tissues or by a rapid blood flow through these organs. Certain observations appear to favor the latter explanation: The circulation of the face reflects very sensitively changes in the emotional state. The facial vessels react more quickly and actively to such drugs as histamine, acetylcholine and nicotinic acid than the vessels in other parts of the body. The face, too, plays a very active role in the dissipation of heat. These vascular phenomena suggest that the blood vessels of the face contain many more arteriovenous shunts or are more widely open than are vessels elsewhere in the body, such as those in the fingers and hand. In the latter parts, the venous blood contains a much smaller percentage of oxygen than the external jugular venous blood. However, under conditions of vasodilatation, such as obtains after the intrabrachial administration of nicotinic acid, the venous blood of the hand and arm resembles in its oxygen content the blood of the external jugular vein. By contrast, the oxygen content of the internal jugular vein changes but slightly after the injection of nicotinic acid into the internal carotid artery.[5] Thus, the circulation of the face under conditions of rest may be compared with the circulation in the arm under conditions of strong vasodilatation.

SUMMARY

The oxygen and sugar contents of the arterial and the internal and external jugular venous blood were determined in a group of subjects with dementia precox.

The oxygen concentration of the external jugular venous blood is much higher than that of the internal jugular venous blood. Because of its relatively high oxygen content, the external jugular venous blood usually has the gross appearance of arterial blood. Approximately three times the amount of oxygen is removed from the blood as it passes through the brain as is removed from the blood as it passes through the face. A similar statement may be made with reference to the sugar uptake of the two organs. These data may be explained either by differences in metabolic requirements of the brain and the face or by differences in the circulation of the two organs. Certain observations favor the latter explanation.

483 Beacon Street.

171 Bay State Road.

ABNORMALLY LARGE BIRTH WEIGHTS OF PSYCHIATRIC PATIENTS

HERBERT BARRY Jr., M.D., Ph.D.
BOSTON

ALTHOUGH numerous factors have been studied in relation to psychiatric disease, the patient's weight at time of birth seems to have received little attention. This is not surprising in view of the many years which elapse between birth and onset of a psychosis. Nevertheless, pathologists have noted that premature infants are susceptible to intracranial hemorrhage or anoxia during parturition. It is also well known that abnormally large babies are apt to have difficult deliveries. There is thus at least a theoretic justification for investigating the birth weights of a series of psychotic patients and comparing these weights with those for the normal population. The only psychiatric study of this type appears to be that of Benda,[1] who found that most patients with mongolism weighed 9 pounds (4,000 Gm.) or over at time of birth.

A number of authors have compiled statistics on average weights at birth for unselected maternity cases which indicate that large babies (weighing over 4,000 Gm.) do not constitute much more than 5 per cent of all births.

METHOD AND RESULTS

Data were obtained from the anamneses of 750 patients who had been admitted for the first time to Greystone Park, N. J., and 225 patients from the psychiatric ward of the Massachusetts General Hospital, and all information on weights at birth was tabulated. The group from Greystone Park were young psychotic patients, similar to a group described previously [2] except that they had all been admitted for the first time between 1937 and 1945. The 225 patients from the Massachusetts General Hospital were mostly psychoneurotic, with some patients with psychosomatic disturbances, and had been admitted during the years 1942 to 1945, inclusive. Anamneses at the Massachusetts General Hospital were secured by a physician and those at Greystone Park by a psychiatric social service worker. Weights at birth were usually given to the nearest ½ pound (226 Gm.) for the psychotic patients, though some were given to the nearest ounce (28 Gm.). Some

From the Department of Neurology and Psychiatry of the Harvard Medical School, and the Department of Psychiatry of the Massachusetts General Hospital.

1. Benda, C.: Mongolism and Cretinism, New York, Grune & Stratton, Inc., 1946.

2. Barry, H., Jr.: Incidence of Advanced Maternal Age in Mothers of One Thousand State Hospital Patients, Arch. Neurol. & Psychiat. **54**:186-191 (Sept.) 1945.

were approximations, such as "6 or 7 pounds," or "8 or 9 pounds." In these instances the lowest weight mentioned was used in the tabulation. In a number of protocols the patient was merely described at birth as "heavy," "average" or "small." These were tabulated separately, and the total number of patients are presented for each of these categories (table).

In many instances no data on weights at birth were obtainable. This was in large part due to the great lapse of time between the birth of the patient and his subsequent commitment. In general, the older the patient, the more difficult it becomes to secure information concerning his birth. Thus, at Greystone Park the percentage of patients for whom birth weights were obtained decreased from 75 per cent (for patients under 25) to 33 per cent (for patients over 30). A similar trend was found at the Massachusetts General Hospital, the figures ranging from 48 per cent, for patients under 20, to 3 per cent, for patients over 40. When the figures were analyzed according to source of information, it was found that 55 per cent of the records from the Massachusetts General Hospital for which the mother was informant contained data regarding the weight at birth, while only 13 per cent of the records with informants other than the patient's mother had data concerning weight at birth. The percentage of records with data on weight at birth is somewhat larger for psychotic patients at Greystone Park, since the closest relative is routinely asked to appear for an interview; this procedure, of course, could not be insisted on to the same extent with the psychoneurotic patients who were treated at the Massachusetts General Hospital.

In order to avoid too large a percentage of patients whose birth weights were unknown, which might make values ambiguous, only patients under 30 years of age were included in the final tabulation of birth weights of patients at Greystone Park. There were 462 such patients. Of these, data were not available for 154; of the remaining 308, 30 per cent either were described as heavier than average or stated specifically that they weighed 9 pounds or over at birth (table).

	No. of Patients
Weight stated in pounds	
9 or over	76
6 to 8	163
Under 6	21
Total	260
9 lb. or over, 29.2%	
Weight described	
"Heavy"	15
"Average"	28
"Light"	5
Total	48
"Heavy," 31.1%	
No information	154
Total number of patients (aged 30 or under)	462

If all the patients whose weight at birth was unknown were babies of average or less than average weight (an unlikely supposition), at least 20 per cent of the patients under 30 were reported as having been large babies. This is at least four times the expected incidence of overweight babies as reported by other investigators,[3] who have

3. (*a*) Von Reuss, A. R.: Diseases of the Newborn, New York, William Wood & Co., 1921, pp. 1-2. (*b*) Anderson, N. A.; Brown, E. W., and Lyon, R. A.: Causes of Prematurity: Comparison of Maternal Histories of Premature and of Full Term Infants, Am. J. Dis. Child. **61**:72-87 (Jan.) 1941.

recorded percentages ranging from 2.9 to 5.1 of unselected patients as weighing over 9 pounds (4,000 Gm.) at birth.

Birth weights of psychoneurotic patients at the Massachusetts General Hospital showed a similar distribution. Of the 61 patients whose anamneses were furnished by the mother, data concerning weight at birth were available for 34 (56 per cent). Nine patients weighed 9 pounds or over at birth. Thus, 26 per cent of the patients for whom birth weights were given, or 15 per cent of all patients on whom the mother acted as informant, were large babies. While the number of patients is small, the percentages are substantially similar to those noted for psychotic patients. By contrast, in a series of 12,000 consecutive deliveries from the obstetric service of the Boston City Hospital, it was found that the percentage of babies over 9 pounds showed some variation from year to year, with a maximum of 6.5 per cent in 1937 and a minimum of 5.3 per cent in 1939. These data were made available through the courtesy of Dr. Frederick L. Good.

COMMENT

Since the data on weights at birth are based on reports made many years previously, there are obviously many possibilities of inaccuracy or error. However, in a large series of patients such inaccuracies should tend to cancel each other unless there is a consistent bias which would lead a number of informants to exaggerate or distort their reports in the same direction. That there might be a tendency to exaggerate birth weights cannot be denied. Actually, the substantial number of patients (6 per cent) who are reported as weighing 12 pounds or over at birth might be considered presumptive evidence of such exaggeration. For this reason, the results must be considered as tentative until they can be confirmed by checking the informant's statements against hospital records or by obtaining other objective verification. At the same time, the reported incidence of overweight babies is so striking that it seemed desirable to publish preliminary figures.

Pending confirmation, any extended discussion of theoretic implications may appear premature. For the same reason, a more detailed report on diagnoses and relationship to other factors which have been supposed to be related to birth weight, such as maternal age,[4] diabetes,[5] and other conditions [6] will be deferred. However, it should be stated that

4. Curtis, A. H.: Obstetrics and Gynecology, Philadelphia, W. B. Saunders Company, 1933, vol. 2, p. 137.

5. Miller, H. C.: The Effect of the Prediabetic State on the Survival of the Foetus and the Birth Weight of the Newborn Infant, New England J. Med. **233**: 376-378 (Sept. 27) 1945.

6. Goldstein, H.: The Relation of Order of Birth to Other Birth Factors, Child Development **9**:127-147 (March) 1938.

in this series the male patients on the average were heavier at birth than the female patients. The differences observed are consistent with those which have been reported by previous investigators for normal persons and support the belief that these reported birth weights have some relation to actual birth weights.

A point concerning methodology may be briefly emphasized. Attempts to obtain birth weights of older patients are likely to be unsatisfactory, and the percentage of patients whose birth weights are unknown may be so high as to result in abandonment of any investigation; however, birth weights may be secured for young patients (16 to 25 years of age) in a high percentage of cases, especially if the mother is available as informant. If attention were focused on younger patients (under 25), it might be possible to evaluate more precisely whether birth weight or other events connected with birth and infancy have any significance as predisposing factors in psychiatric disease.

CONCLUSIONS

Twenty per cent of a series of psychiatric patients for whom data were obtainable were reported to have been large babies or to have weighed 9 pounds (4,000 Gm.) or over at birth.

The difficulty of securing data on weights at birth can be minimized by limiting investigation to patients who are under 25 years of age.

Massachusetts General Hospital.

Obituaries

CHARLES LEWIS ALLEN, M.D.
1860-1946

On May 28, 1946, Dr. Charles Lewis Allen, one of the pioneers of Western psychiatry, passed to his rest after a lingering illness. His mind remained young and receptive until a cerebral vascular accident left him aphasic and physically helpless.

Dr. Allen was born on Sept. 24, 1860, at Charleston, S. C. He was the youngest of six children, the eldest of whom lost his life in the War between the States. Lewis attended private schools in Charleston until, in his teens, he entered the military academy in Charlotte, N. C.

For his higher education he went to the University of Virginia in 1879, and there in 1882 he took the degree of Bachelor of Science. At first he had decided to be a chemist, but he later conceived the desire to study medicine, taking up his medical studies at the University of Maryland, which granted him a degree in 1887.

In 1888, immediately after his marriage to Miss Ellen Augusta O'Connor, of Charleston, he and his bride went to Europe, where he took up postgraduate studies in Vienna, Berlin and Paris and continued these on a second trip abroad, in 1895. While in Paris, he came under the influence of the great Charcot, whose personality and accomplishments were a great inspiration to him and led him to seek a career in neurology and psychiatry.

After focusing his interest in the field of neuropsychiatry, he worked as clinical assistant in neurology at the Vanderbilt Clinic, Medical Department of Columbia University (1890-1892), and later as assistant physician and pathologist at the New Jersey State Hospital, at Trenton (1899-1906). He was chief of the neurologic clinic, Los Angeles Medical Department, University of California (1908-1913). For many years he was associated with the psychopathic department of the Los Angeles County Hospital, holding the following positions: physician for nervous and mental diseases (1910-1941), physician in charge of the Los Angeles County Psychopathic Hospital (1914-1919) and member of the Insanity Commission (1909-1941).

From his father he inherited his love for teaching, and during all his long and varied life he lectured and taught in his chosen field. He was instructor in medicine at the New York Polyclinic Medical School and Hospital (1890-1892); clinical professor of neurology, Georgetown

University School of Medicine, Washington, D. C. (1897-1899), and assistant professor of neurology, Los Angeles Medical Department, University of California (1910-1913). From 1915 to 1941 he was clinical professor of neurology and psychiatry, College of Medical Evangelists, Los Angeles.

During World War I, since he was beyond the age for active military service, he enlisted as a contract physician and worked as psychiatrist in the mustering office at Camp Lewis, American Lake, Wash. After the armistice he served as neuropsychiatrist for the United States Veterans Bureau from 1919 until his retirement from practice.

He was author of a number of contributions in neurology and psychiatry. In addition, he wrote a number of articles on neurologic and psychiatric subjects in Albert H. Buck's "Reference Handbook of the Medical Sciences" (New York, W. Wood & Co., 1913-1923). He also translated from the German Bing's "Textbook of Nervous Diseases" (New York, Rebman Company, 1915).

For years he was an active member of the American Medical Association, the American Psychiatric Association and the Association for the Study of Internal Secretions, and he was founder of the Los Angeles Society of Neurology and Psychiatry. For a number of years he belonged to a local group known as the Psychopathic Association, the object of which was to improve conditions in the care and general treatment of the insane, particularly by means of improved laws in the State of California. His name for many years has been on the editorial staff of the *Journal of Nervous and Mental Disease*.

In his long and active career, Dr. Allen exemplified the real spirit of the profession of medicine by his kind consideration for his patients, his active interest in medical progress and his high standards of ethical practice. He will be missed by those who came to know him.

DR. C. U. ARIENS KAPPERS

1877-1946

On Sunday afternoon, July 28, 1946, C. U. Ariëns Kappers was found dead in the lovely garden of his home in Amsterdam. He was the director of the Central Institute for Brain Research and had been professor of comparative anatomy at the University of Amsterdam since 1928. His death marks the passing of a great Netherland scientist.

In his youth he worked in the laboratory of Edinger, in Frankfort on the Main, where he studied the relationship of the nuclei of the central nervous system. It was there that he conceived the idea that led him to the famous theory of neurobiotaxis. It appeared to him that there were differences in the location of nuclei in the various species of animals. He explained this movement of the nuclei by a process of "tropism," or "taxis," which was caused by stimuli flowing toward the nuclei. As the stimuli increase in number and strength, the nerve cells move in the direction of the stimuli, just as, for example, many organisms are drawn toward light. When he began his work in the Central Institute for Brain Research in 1909, he had the opportunity to elaborate on the theory of neurobiotaxis, and, with the help of several associates, he established his theory so well that by now it is generally accepted as one of the laws determining the construction of the central nervous system.

Ariëns Kappers gathered a quantity of material which was so well treated technically that his collection became a treasury from which many scientists could enrich their knowledge.

He gave great impetus to comparative neurology, trying always to find the connection between form and function, bringing light in many fields which were dark before and opening vistas no one had known existed. The results of his work were published in many papers and collected in two great textbooks: "Die vergleichende Anatomie des Nervensystems der Wirbeltiere und des Menchen" (Haarlem, de Erven F. Bohn, 1920 and 1921) and "The Comparative Anatomy of the Nervous System of Vertebrates, Including Man" (together with G. C. Huber and Elizabeth C. Crosby) (New York, The Macmillan Company, 1936).

Ariëns Kappers' work was not limited to anatomy. He also contributed to anthropology, in which he became interested because of his experiences in China and, especially, in Beirut, Syria, where he worked as a visiting professor.

He was offered a professorship at Yale University in 1928 but declined in favor of a similar position at the University of Amsterdam.

Ariëns Kappers had a universal mind, was interested in philosophic and religious problems and benefited many by publishing his ideas in these fields. Although many scientific honors were conferred on him, he remained the same: the quiet worker in his laboratory who, day after day, studied nature in its various aspects; who saw more than the plain objects, and who always remained susceptible to feelings of wonder, which is the first step toward discovery. From his rich mind he gave much to his friends, who will never forget him.

Translated from *Nederlandsch tijdschrift voor geneeskunde* (Aug. 10, 1946).

Abstracts from Current Literature

EDITED BY DR. BERNARD J. ALPERS

Anatomy and Embryology

BASILAR IMPRESSION: THE POSITION OF THE NORMAL ODONTOID. W. W. SAUNDERS, Radiology **41**:589 (Dec.) 1943.

Saunders examined 100 "normal" lateral roentgenograms of the skull and attempted to correlate statistically the relation of the tip of the odontoid to the "Chamberlain line." The latter runs from the posterior margin of the hard palate to the dorsal margin of the foramen magnum. Normally, the odontoid tip is assumed to fall below this hypothetic line.

While in the 100 "normal" skulls the arithmetical mean position of the odontoid tip was 1 mm. below the line, in 35 skulls it was above the line. In 1 case it was 8 mm., and in another 7 mm., above this hypothetic line. Statistically, it was calculated that normally in 1 of 5 skulls the odontoid tip will lie more than 2 mm. above; in 1 of 19 skulls, more than 5 mm. above; in 1 of 64 skulls, more than 7 mm. above, and in 1 of 800 skulls, more than 10 mm. above.

TEPLICK, Philadelphia.

Physiology and Biochemistry

EXPERIMENTAL STUDY OF THE RELATION BETWEEN PRESSURE OF THE RETINAL ARTERIES AND INTRACRANIAL PRESSURE. S. OBRADOR ALCALDE and M. RIVAS CHERIF, Bol. Lab. de estud. med. y biol. **2**:27 (Jan.-Feb.) 1943.

Eight dogs were used for the experiments. They were anesthetized with pentobarbital sodium. The lids were excised to facilitate observation. Retinal arterial pressure was measured by Baillart's retinal dynamometer. The diastolic pressure was determined at the point when retinal arterial pulsations appeared and the systolic pressure when they disappeared as the pressure continued to be increased. Intracranial pressure was increased by connecting the cisterna magna with a bottle containing isotonic solution of sodium chloride under pressure. The pressure was at first elevated to 20 to 30 cm. of water for five to ten minutes. Two or three readings of retinal pressure were then made. The pressure was then raised to higher levels, up to 80 cm. of water, with repetition of the retinal pressure readings. The systemic blood pressure was recorded at the same time in the femoral artery. In about half of the experiments, there was a progressive rise in retinal diastolic and systolic pressure as the intracranial pressure increased. In the other half, there was some increase in retinal pressure with little change in the systolic as compared with the diastolic retinal pressure. In the second series of experiments, no increase in retinal pressure was noted, in spite of continued increase in intracranial pressure. No increase in systemic pressure was found even when the intracranial pressure reached 80 cm. of water. The retinal pressure is not constantly elevated in cases of intracranial hypertension accompanying brain tumor, for the rise is not so rapid as in experimental conditions, time being allowed for the operation of compensatory mechanisms.

SAVITSKY, New York.

EXPERIMENTAL INVESTIGATIONS ON CAUSES OF CENTROGENIC HYPERTENSION ASSOCIATED WITH INTRACRANIAL INCREASE IN PRESSURE. H. BIERHAUS, Arch. f. klin. Chir. **203**:257 (June 15) 1942.

Bierhaus states that intracranial traumatic hemorrhage causes changes in peripheral parts of the organism in addition to the local irritation. Effects on the

respiration and the circulation are of the greatest importance. The author studied these changes in dogs, utilizing the sphygmographic method of Frank and Broemser. The effect of trepanation and of increased intracranial pressure was thus determined. The centrogenic hypertension which develops subsequent to intracranial pressure is mild at first but later becomes more pronounced. This hypertension is caused by a great increase in the elastic resistance at the termination of the arterial system, while at the same time there is a decrease in the beat and minute volumes and in the pulse frequency. Thus, there is not only hypertension due to peripheral resistance but hypertension due to elastic resistance. Not only the vagus nerve but also the vasomotor center is irritated. In a second experiment, the action of various increases in pressure in the cranium was ascertained. A noticeable failure of the circulation was evident at the beginning of a third experiment, but after intramuscular injection of synephrin tartrate there was an increase in blood pressure. In subsequent experiments the vagus nerve was cut on both sides; then the vagus nerve and the sympathetic fibers were cut, and, finally, all nervous influences were eliminated. Studies were also made on the action of vasopressin, acetylcholine and epinephrine. The author concludes that in the presence of an intracranial increase in pressure there results not only an irritation of the sympathetic centers but also a flooding out of vasopressin into the blood stream. A peripheral resistance hypertension and an elasticity hypertension are produced in this manner.

J. A. M. A.

Diseases of the Spinal Cord

GUNSHOT WOUNDS OF THE MAXILLOFACIAL REGION WITH SPINAL COMPLICATIONS. G. D. ARONOVICH, Am. Rev. Soviet Med. **1**:344 (April) 1944.

Aronovich observed 12 patients with combined wounds of the maxillofacial region and injuries of the spinal cord. The diagnosis of this combination of lesions requires a careful history and examination. At times these are difficult to obtain because the patient may be in shock or may have difficulties of speech, phonation or respiration.

In the author's experience, the involvement of the spinal cord associated with maxillofacial wounds is often unrecognized during the various stages of evacuation of the wounded. Concussion or contusion of the spinal cord is rather characteristic, as is fracture of a cervical vertebra. In this series of patients complete recovery from the symptoms referable to the spinal cord was the rule, but a few had mild residual neurologic sequelae. Therapy ranged from surgical intervention to conservative orthopedic management, physical therapy and medical gymnastics.

GUTTMAN, Philadelphia.

NEUROPSYCHIATRIC COMPLICATIONS FOLLOWING SPINAL ANESTHESIA. H. EDWARD YASKIN and BERNARD J. ALPERS, Ann. Int. Med. **23**:184 (Aug.) 1945.

Yaskin and Alpers report 6 cases in which neurologic and emotional disturbances developed after spinal anesthesia. They also mention a case of metastatic neoplasm of the spinal cord which was discovered after spinal anesthesia. In this case the anesthetic agent was suspected at first to have been the cause of the myelitic syndrome. In 4 cases the complications occurred immediately after the use of the anesthetic agent. The syndromes were of a myelitic or myeloradicular nature. Clinically, in all these cases of neuropsychiatric complications following spinal anesthesia little or no recovery was apparent after periods ranging from one to four years. The spinal fluid showed no characteristic abnormality. There was no pleocytosis or increase in total protein except in 1 case. In 2 of the reported cases the disturbance was in the nature of a conversion hysteria "paralysis" of the lower extremities. The conversion mechanism was conditioned by the patient's subjective experience with spinal anesthesia. The case of metastatic neoplasm

of the spinal cord, which came to light immediately after spinal anesthesia, was presented to illustrate the importance of keeping in mind the possibility of preexisting neurologic disease when evaluating the role of spinal anesthesia in the causation of postoperative neurologic sequelae.

The authors state that many neurologic complications, of great diversity, immediate or remote, mild or severe, temporary or permanent, may follow spinal anesthesia. Serious complications in normal persons are apparently relatively infrequent, and in properly selected cases spinal anesthesia holds an important, and almost indispensable, place in the surgeon's armamentarium.

GUTTMAN, Philadelphia.

ACUTE SPINAL EPIDURAL ABSCESS AS A COMPLICATION OF LUMBAR PUNCTURE. LEO RANGELL and FRANK GLASSMAN, J. Nerv. & Ment. Dis. **102**:8 (July) 1945.

Rangell and Glassman report the occurrence of an acute epidural abscess following a diagnostic lumbar puncture in a 28 year old Negro soldier. Two or three days after the procedure the patient began to complain of severe pain in the lower part of the back, which radiated down along the posterior aspects of both lower extremities. The pain became more severe; elevation of temperature appeared, and eleven days after the puncture complete flaccid paraplegia suddenly developed. Examination revealed decided tenderness, spasm and edema of the paravertebral muscles in the lumbar region on the left side. Laminectomy was performed, and an extensive epidural abscess was evacuated. After this the patient showed marked improvement, although motor function had returned only partially six weeks later.

Although the importance of epidural abscess has been recognized since Dandy's study, in 1929, this is the first case reported as a complication of spinal puncture. The clinical picture of the condition is characteristic, being marked by the occurrence of root pains, followed by a latent period and then by evidence of compression of the cord. Fever, tachycardia and leukocytosis are present, and the finding of localized tenderness of the spine and edema and redness of the paravertebral muscles clinches the diagnosis. A diagnostic lumbar tap is probably contraindicated, owing to the danger of introducing infection into the subarachnoid space, with subsequent meningitis. The most usual site of involvement is the interscapular area, while the region of the cauda equina is next. The organism responsible for epidural abscess is almost always the staphylococcus, which seems to have a special affinity for the loose areolar tissue which makes up the epidural space. A surprising fact is the nonoccurrence of epidural abscess following lumbar puncture in cases of purulent meningitis. Neuropathologic studies have shown that the symptoms of the condition are attributable not only to direct compression of the cord but also to the secondary effects of venous and lymphatic obstruction. Treatment consists of the prompt and adequate surgical evacuation of pus, with open drainage favored by most authors.

CHODOFF, Langley Field, Va.

CORD BLADDER; RESTORATION OF FUNCTION BY TRANSURETHRAL OPERATION. G. J. THOMPSON, U. S. Nav. M. Bull. **45**:207 (Aug.) 1945.

Thompson says that paralysis is so extensive in the vast majority of cases of injury to the cord that urination is impossible and remains so for many months. The distended bladder must be emptied. In the early phase of the paralysis the bladder of a few of these patients can be emptied by manual pressure applied in the suprapubic region. As time goes on these few usually find that the bladder cannot be completely emptied. The majority of paralyzed patients require drainage of the bladder through a catheter placed suprapubically through a stab wound, through a boutonniére incision in the perineal portion of the urethra or through the penis. No matter where placed, the catheter must be irrigated regularly and

changed at regular intervals. After a lapse of weeks or months, when the catheter is removed, there develops in some of these patients what is loosely called an automatic bladder. They void at irregular intervals but are usually incontinent to some degree; hence a urinal must be worn. If the indwelling catheter can be dispensed with, the patient's condition improves rapidly. Some patients will have spontaneous recovery of function. Patients who are unable to urinate after maximum nerve recovery has taken place can regain voluntary control of bladder function as the result of a properly performed transurethral resection of the vesical neck. It is important to remove a substantial amount of tissue. The resection of a few pieces from the posterior half of the vesical neck usually accomplishes nothing; tissue must be excised from the entire circumference of the outlet. Only in this way can the resistance of the retention mechanism be diminished sufficiently so that an increase of pressure within the abdomen, accomplished by straining, will squeeze the bladder dry. The most gratifying feature is that between urinations the patient has perfect control. Depending on fluid intake, four or more hours may elapse between urinations. If fluids are restricted in the evening, the patient can sleep all night. The author presents the histories of 5 patients. Voluntary bladder function was restored in all cases by transurethral resection of the hypertrophied internal sphincter. Prior to operation these patients had suffered from urinary retention and dribbling overflow incontinence. Since operation they have been able to void at will; they empty the bladder completely and have good control.

J. A. M. A.

Peripheral and Cranial Nerves

NEURINOMA OF THE FACIAL NERVE. ROBERT M. BOGDASARIAN, Arch. Otolaryng. **40**:291 (Oct.) 1944.

Bogdasarian reports a case of facial neurinoma occurring in a white man. The patient presented a history of diminishing auditory acuity of ten years' duration; progressive paralysis of the right side of the face of over five months' duration, becoming complete three days prior to his admission to the hospital, and slight pain in the right ear. He did not complain of vertigo or tinnitus but had a feeling of fulness in the ear. Examination revealed the drum membrane to be pinkish gray and bulging slightly in the posterior inferior quadrant. Taste sensation for all qualities was absent on the anterior two thirds of the right side of the tongue. There was no nystagmus. Hearing was poor in the right ear, and in the Weber test the sound was lateralized to the right. The left ear was normal. The audiogram for the right ear showed losses of from 40 to 50 decibels in all frequencies for hearing by air conduction, with normal hearing by bone conduction. After myringotomy a reddish mass was observed protruding through the posterior inferior quadrant of the drum membrane. Since bleeding was slight, a diagnosis of neurinoma was made and was confirmed by biopsy. The usual postauricular approach to the mastoid process was made, and a neoplastic mass was seen to fill the middle ear. It had eroded the bone of the middle fossa, so that the dura was visible. The tumor involved the horizontal portion of the facial nerve, and the growth was removed as completely as possible. Postoperative convalescence was uneventful, but no change resulted in the facial paralysis.

RYAN, Philadelphia.

MÉNIÈRE'S DISEASE IN A DEAF-MUTE. WALTER E. DANDY, Arch. Surg. **50**:74 (Feb.) 1945.

Dandy reports the case of a deaf-mute man aged 22 with typical Ménière's disease. When the right eighth nerve was sectioned, a congenital anomaly of the petrous portion of the temporal bone and the porus acusticus was noted, and the auditory nerve was observed to be abnormally small. There is no reason to believe that Ménière's disease is more common in deaf-mutes than in the general popula-

tion, and therefore the combination of the two conditions in this case must be considered incidental. Congenital deaf-mutism is usually due to a defective or malformed labyrinth, whereas the cause of Ménière's syndrome lies in a congenital or acquired lesion of the auditory nerve.

LIST, Ann Arbor, Mich.

PERONEAL PALSY AS A COMPLICATION OF PARTURITION. ELEANOR MILLS, J. Obst. & Gynaec. Brit. Emp. **52**:278 (June) 1945.

Mills reviews 7 cases of peroneal palsy, 3 from personal observation and 4 from hospital records. These cases show that peroneal palsy follows difficult deliveries which entail extraction by forceps. The paralysis is unilateral. It occurs on the side opposite the one occupied by the greatest diameter of the fetal skull in the majority of cases. The cause in most cases must be instrumentation. In the minority direct pressure of the fetal head may be the cause, though in these, too, instrumentation cannot be excluded. Pain and paresthesia, though transient and not severe, precede the paralysis. The paralysis affects the dorsiflexors and evertors of the ankle. The paralysis will usually clear up, and in those cases in which permanent damage is done the final paralysis is considerably less than the initial loss of function.

J. A. M. A.

FACIAL PALSY IN CLOSED HEAD INJURIES: THE PROGNOSIS. J. W. TURNER, Lancet **1**:756 (June 10) 1944.

Turner discusses two types of post-traumatic facial palsy: that occurring at the time of injury and that of delayed onset. The second type developed two to eight days after the injury in the author's series of cases. There were 34 cases of this type (bilateral in 1 case), in 11 of which the paralysis was complete. In 19 cases the paralysis had cleared completely in three weeks; in 5 cases it took seven weeks to clear; in 1 case, twelve weeks, and in 5 cases, four months, though whether in all the last cases recovery took fully that much time is not known. In 1 other case there was partial recovery in six to eight months, and in 1 case, in which acute otitis media was a complication and the palsy developed five days after injury, no improvement appeared in six months. In 1 case the course was not followed. In the case of bilateral complete palsy recovery occurred in eight weeks.

Of the 36 cases of immediate palsy, the paralysis was complete in 19. In 9 of the 36 cases the palsy cleared in about three weeks, and in 15 cases recovery took six to eight weeks. In 3 cases recovery took three months, but in 6 others the patient did not start to regain normal movements until after this time, and then slow, incomplete recovery began. In 3 cases no improvement occurred in eighteen months to two years after injury; in 2 of these concomitant otitis media developed. The most troublesome feature of incomplete recovery was the presence of associated movements.

Turner believes that it is impossible to tell in the early stages whether a complete palsy will clear rapidly or not; but after three weeks if the faradic response is still obtainable the outlook is good for complete recovery. Deafness on the same side is a common accompaniment of the palsy, but there is no relation between the degree of deafness and the time of recovery. Turner also thinks it is probable that the petrous part of the temporal bone is always fractured in cases of traumatic palsy whether or not a fracture appears in the roentgenogram. The exact cause of the palsy is uncertain, but Turner suggests laceration or intraneural vascular accident as a cause of immediate paralysis and pressure on the nerve by blood as the cause of delayed palsy.

The treatment recommended is a wire splint hooked around the mouth and behind the ear to support the muscle. Massage upward and backward can be done by the patient himself. Individual movements of facial muscles can be practiced in front of the mirror. "Regular treatment with the galvanic current

is probably worth while, though experimental evidence of its value is still meager." The author feels that this series of cases provides no brief for surgical intervention for at least six months after injury; then exploration of the canal may be advisable.

McCARTER, Boston.

POLYNEURITIS FOLLOWING SULFANILAMIDE THERAPY. R. MÜLLER, Acta med. Scandinav. **121**:95 (May 14) 1945.

Müller reports 7 cases of polyneuritis following chemotherapy in 2 women and 5 men. The patients, who were admttted to the neurologic clinic of the Serafim Hospital in Stockholm, were between the ages of 3 and 56 years. Two of them were treated with dimethyldisulfanilamide (uleron), 1 with sulfanilamide, 2 with sulfathiazole, 1 with sulfanilamide, sulfapyridine and sulfathiazole and 1 with sulfapyridine. In the cases of polyneuritis caused by sulfanilamide, sulfapyridine and sulfathiazole the symptoms were more extensive and more pronounced than in cases in which dimethyldisulfanilamide or sulfamethylthiazole was the causative factor. In addition there was less motor disturbance than in polyneuritis caused by the latter drugs. The incidence of polyneuritis is probably greater after treatment with dimethyldisulfanilamide or sulfamethylthiazole than with the administration of other nonmethylated sulfanilamide compounds. The possibility that in some cases polyneuritis may result from purely toxic damage to the nerve tissues cannot be excluded. In general, an allergic reaction seems to be responsible for its occurrence, as polyneuritis may result from serum administration. Previous damage to the nervous system, achylia and thiamine deficiency may be predisposing factors which render the patient susceptible to polyneuritis. Muscular exertion may cause a latent polyneuritis to become manifest. To prevent the occurrence of polyneuritis, chemotherapy should be practiced for as short a period as possible. Intermittent administration of the drug should be avoided. Methylated preparations should not be employed. Patients who on the occasion of previous treatment presented signs of hypersensitivity, such as drug fever or exanthems, should be desensitized before repeating chemotherapy. Polyneuritis due to administration of sulfonamide compounds suggests that further chemotherapy should not be employed.

J. A. M. A.

Vegetative and Endocrine Systems

DERMATOMYOSITIS. B. V. JAGER and L. A. GROSSMAN, Arch. Int. Med. **73**:271 (April) 1944.

Jager and Grossman report the clinical and laboratory findings, including biopsy observations on muscle, in 9 adult patients, 7 men and 2 women, with dermatomyositis. The ages ranged from 32 to 61 years. The duration of illness prior to establishment of the diagnosis varied from five weeks to eight years. Every patient complained of muscular stiffness, and 8 of the 9 patients had muscular weakness and tenderness. Edema, which was chiefly in the periorbital region, was present in every patient at some stage of the illness. Dermal lesions, of various types, were present in 7 of 9 patients. Seven patients had lost from 10 to 100 pounds (4.5 to 45 Kg.) in weight. Six patients had muscular atrophy, and a similar number complained of dyspnea; but emphysema and cardiac failure may have produced this symptom. Five patients had bouts of elevated temperature at some time during the course of their illness. A history of Raynaud's disease was elicited from 4 patients, and 2 of these had sclerodermatous changes in the hands. One patient had diffuse scleroderma without a history of Raynaud's disease. Other, less common, findings were hoarseness, in 4 patients; cough; paresthesias; hepatomegaly; arthritic pains, and muscular cramps and muscular twitching, each in 3 patients. Dysphagia, diaphragmatic impairment and cardiac arrhythmia occurred in 2 patients, while 1 patient experienced diplopia.

The patients were studied extensively, and the only consistent abnormality found was spontaneous creatinuria. The reactions to overcooling, as shown by

studies of the cutaneous temperature, gave results typical of Raynaud's syndrome in the 4 patients with a history of this disturbance and in another patient without such a history. Biopsy specimens of skeletal muscles failed to reveal any lesion specific for dermatomyositis, but microscopic study showed abnormalities in all specimens.

Several unsuccessful attempts at therapeutic measures were reported. One patient obtained symptomatic relief from the oral administration of salicylates. Frequent hot baths, however, gave temporary symptomatic relief. Five of the 9 patients received 40 mg. of alpha tocopherol orally each day for one to several months, without obvious benefit. Fever therapy with typhoid vaccine seemed to have benefited 1 of 3 patients.

The authors concluded that "the variability of the manifestations in this series of cases was sufficient to arouse doubt as to whether 'dermatomyositis' is a single clinical entity. A similar view is obtained from reading previous reports of cases of this disorder. In addition to clinical, laboratory pathologic data, it may be necessary to follow the course of the illness for a prolonged period before the diagnosis may be established with certainty."

GUTTMAN, Philadelphia.

Treatment, Neurosurgery

SUCCESSFUL TREATMENT OF EXPERIMENTAL WESTERN EQUINE ENCEPHALOMYELITIS WITH HYPERIMMUNE RABBIT SERUM. J. ZICHIS and H. J. SHAUGHNESSY, Am. J. Pub. Health **35**:815 (Aug.) 1945.

Fifty-five guinea pigs were treated with specific hyperimmune rabbit serum having a titer of 500 to 1,000 units when they became sick following intralingual injection of western equine encephalomyelitis virus. Of this number 67.3 per cent recovered. Of the 41 guinea pigs used as controls, 1 recovered spontaneously and 40 died. Serum therapy was less effective in rhesus monkeys, giving a recovery rate of 45.5 per cent, as against no recoveries in the control group. These animals were treated with serum at the onset of fever following intracerebral injection of the virus. With this method of injection the virus produces a fulminating type of the disease which is more difficult to treat. A western equine encephalomyelitis antiserum has been prepared by hyperimmunization of rabbits which is effective in treating the experimental disease even after the animals show evidence of involvement of the central nervous system. It is believed that the successful treatment of the disease in these experiments can be attributed to the use of adequate quantities of antiserum of high potency administered by a route which made the serum antibodies readily available to the animal.

J. A. M. A.

PENICILLIN TREATMENT OF NEUROSYPHILIS: A PRELIMINARY REPORT OF SEVENTY CASES FOLLOWED FROM FOUR TO TWELVE MONTHS. AUGUSTUS S. ROSE, LAURENCE D. TREVETT, JOSEPH A. HINDLE, CURTIS PROUT and HARRY C. SOLOMON, Am. J. Syph., Gonor. & Ven. Dis. **29**:487 (Sept.) 1945.

The data for this study were compiled from observations on 72 patients who had syphilis of the central nervous system. All the patients were followed from four to twelve months after therapy. One hundred and six patients were treated, and of this group 7 died. The observations on 34 patients are not included because the period of follow-up study was not four months. Penicillin was administered intramuscularly, in doses of 50,000 Oxford units per injection, for a total of sixty injections (3,000,000 Oxford units) to all the patients. The great majority were also given either malaria or fever cabinet therapy in approximately one-half the amount generally accepted as sufficient.

Clinically, it is estimated that of these 70 patients, the condition of 28 was improved, that of 37 was unchanged and that of 5 was made worse. The

greatest percentage of improvement was to be found among the 49 patients with a condition diagnosed as dementia paralytica. The most striking result, however, was shown in the 6 patients with primary optic nerve atrophy, 5 of whom may have had arrest of visual loss.

Examinations of the spinal fluid revealed an immediate response, consisting in an increase of cells and total protein in most of the previously untreated patients, followed by a general gradual reduction in the cell count and total protein content and, later, by a decrease in the Wassermann titer. Comparison of the clinical and the serologic results showed no definite correlation at this stage of observation.

From the data presented, it is believed that penicillin is an active and effective therapeutic agent for late neurosyphilis, but comparison with the serologic results in 30 patients treated by older methods indicates that there is no striking difference at this period of observation. Caution is advised in the interpretation of these results, and the authors state, "We believe that the time has not arrived for the distribution of penicillin for general use in the treatment of neurosyphilis."

GUTTMAN, Philadelphia.

THE PUBLIC HEALTH ASPECT OF MALARIA THERAPY OF NEUROSYPHILIS. WALTER L. BRUETSCH, Am. J. Syph., Gonor. & Ven. Dis. **29**:494 (Sept.) 1945.

Bruetsch reviews the literature on the public health aspect of malarial therapy. From his survey he comes to the conclusion that the danger of disseminating malaria to the community is negligible. After a review of the cases of malaria which have been reported as having their origin through transmission from therapeutic malaria, he is left with the impression that definite proof of this assertion is lacking in almost all instances. The theory that maintenance of malaria in the human host for prolonged periods by direct blood inoculation leads to "asexualization of the plasmodium" is not shared by most malariologists. Unfavorable ecologic requirements explain why accidental transmission through therapeutic malaria practically never occurs.

GUTTMAN, Philadelphia.

HIGH FREQUENCY ELECTRIC CURRENT IN THE TREATMENT OF ALCOHOLIC HALLUCINOSIS. K. Y. GRUENBERG, Am. Rev. Soviet Med. **1**:544 (Aug.) 1944.

Gruenberg reports the histories of 3 patients with "alcoholic hallucinosis" who were successfully treated with high frequency electric current. He believes that so-called alcoholic hallucinosis occurs in the hang-over period, chiefly because of vasoconstriction of the cerebral blood vessels. "High frequency electric current . . . produces a selective vasoparalytic effect, i. e., it counteracts the pathogenic mechanism which forms the basis of the hallucinosis. It is suggested, however, that this is not the only therapeutic mechanism of action of high frequency current in alcoholic hallucinosis just as ischemia is not the only pathogenic factor. It is wholly possible that the positive therapeutic effect obtained by use of high frequency current depends on a number of other factors which contribute to the specific effect on the central nervous system.

GUTTMAN, Philadelphia.

ELECTROCONVULSIVE SHOCK THERAPY AND CARDIOVASCULAR DISEASE. VERNON L. EVANS, Ann. Int. Med. **22**:692 (May) 1945.

Evans reports his observations on a series of 750 patients given electroshock therapy. Among this number were 38 patients with known cardiovascular disease, of whom 19 had presumptive to positive evidence of disease of the coronary arteries. Five of the patients had definite histories of previous occlusions of the coronary arteries. Five patients who had auricular fibrillation were treated during the presence of this abnormality. Nine patients with hypertension were also included in this group. They all had a systolic blood pressure over 200 mm. of mercury.

In one of the patients who had auricular fibrillation and was given electroshock therapy a fever and thoracic rales suddenly developed two days after the last treat-

ment. She then felt pain in the chest, and seven days after the last treatment the patient suddenly became dyspneic and cyanotic, went into shock and died in an hour. A pulmonary embolus was suspected but not proved. Necropsy was not done. This is the only mortality among the patients with known cardiovascular disease.

Evans concludes that electroshock therapy can be given with remarkably little danger in cases of serious organic disease of the cardiovascular system. In this series of 750 patients receiving electroshock therapy, 38 had positive evidence of previous damage to the cardiovascular system. With 1 exception, all the patients survived the electroshock treatment, with remarkably few ill effects and complications. Nearly all the patients treated were suffering from severe mental illnesses, which might well have terminated fatally from undernutrition or suicide if shock treatment had not been used.

GUTTMAN, Philadelphia.

PICROTOXIN IN BARBITURATE POISONING. D. L. BURDICK and E. A. ROVENSTINE, Ann. Int. Med. **22**:819 (June) 1945.

Burdick and Rovenstine report observations on 4 patients who suffered from the effects of barbiturate intoxication. The cases are presented to illustrate the effects of neglected, inadequate, delayed and more immediate treatment. The suggested therapeutic regimen outlined is as follows: an adequate airway, artificial respiration, adequate administration of oxygen, gastric lavage, intravenous fluid therapy, chemotherapy when there is evidence of infection, maintenance of diuresis, good nursing care and, of course, analeptic therapy.

Analeptic therapy should be conservative if the reflexes are active and motor activity is present. Vigorous treatment is for the deeply depressed patient. To such patients picrotoxin may be given in 0.001 to 0.003 Gm. doses intravenously or in 0.003 to 0.006 Gm. doses intramuscularly every fifteen minutes until the desired response is attained. This fractional method is not so effective as the continuous intravenous procedure, which is equally safe if employed with proper caution. The drug is administered at the rate of 0.001 to 0.002 Gm. per minute until the corneal, swallowing or other reflexes appear or until slight twitchings of the facial muscles occur. If the drug is given beyond this point, convulsions may result. These are usually mild and gradually subside as the stimulant is destroyed. Should they be severe, or should milder ones persist, intravenous injection of a barbiturate, such as sodium pentothal, is given slowly to the point of control. Once signs of reflex and motor activity return, picrotoxin is continued intramuscularly in maintenance doses of 0.003 to 0.006 Gm. every fifteen to thirty minutes as indicated. Should regression develop, the same dose is given intravenously until the desired plane of activity is reestablished. In each case treatment must be individual and the drug continued until active reflexes and involuntary movements are maintained.

Since the action of picrotoxin may be delayed as much as ten minutes, caution is to be exercised in its administration. Furthermore, the impression has been gained that the initial response to picrotoxin following depression from the longer-acting barbiturates is slower than is the case with the shorter-acting ones; hence, the analeptic should be given in smaller amounts if its accumulation, with a resultant sudden and severe stimulation, is to be avoided. Convulsions, if they occur, usually are followed by a degree of depression deeper than that existing before their onset.

The amount of picrotoxin necessary to establish the desired plane of activity is unpredictable. The wide variation in dosage seemingly bears little relation to the quantity of barbiturate taken. Although 0.02 Gm. of picrotoxin is dangerously toxic to a normal adult, doses ranging from 1.079 to 2.296 Gm. have been employed for patients poisoned by barbituric acid derivatives.

Burdick and Rovenstine state that early and adequate analeptic therapy with picrotoxin may prevent death, obviate a prolonged illness and result in a complete, or more nearly complete, recovery. Each case must be judged by the condition of the patient when admitted to the hospital and managed according to the response shown toward undelayed treatment. If this is prompt, the more expensive and time-consuming measures should not be necessary. GUTTMAN, Philadelphia.

MENINGOCOCCIC MENINGITIS TREATED WITH SULFADIAZINE AND SULFAMERAZINE: A THREE YEAR STUDY. LEWIS K. SWEET, EDITH DUMOFF-STANLEY and HARRY F. DOWLING, Ann. Int. Med. **23**:338 (Sept.) 1945.

Data are presented in an attempt to evaluate the results of treatment in 207 patients with meningococcic meningitis.

The patients were treated either with sulfadiazine or sulfamerazine as the principal therapeutic agent. The gross mortality was 10.1 per cent. There was no significant difference in the fatality rate in patients treated with the two drugs. Fewer patients were seen in 1944 than in 1943, and the illness was less severe. The etiologic diagnosis was established immediately from direct examination of the cerebrospinal fluid in 188 (90.8 per cent) of the group of 207 patients.

The factors of the greatest prognostic significance at the time of the patient's admission were the presence or absence of the coma-delirium state and the age of the patient. For patients who were delirious or in coma, the presence of numerous micro-organisms in, or the virtual absence of dextrose from, the initial specimen of cerebrospinal fluid added to the gravity of the prognosis.

There was no relationship between the concentration of the sulfonamide compound in the blood and the outcome of the meningitis. Massive doses of the sulfonamide drugs are not necessary for most patients with meningococcic meningitis. Those patients who are obviously more ill require more vigorous treatment. GUTTMAN, Philadelphia.

BLOCKING OF THE MIDDLE CERVICAL AND STELLATE GANGLIONS WITH DESCENDING INFILTRATION ANESTHESIA: TECHNIC, ACCIDENTS AND THERAPEUTIC INDICATIONS. A. DE SOUSA PEREIRA, Arch. Surg. **50**:152 (March) 1945.

Numerous methods have been devised to block the stellate ganglion with local anesthesia, but most of them possess no accurate bony points of reference for the insertion of the needle and they frequently lead to disagreeable, or even dangerous, accidents by injury to the pleura, lung, subclavian or vertebral artery or brachial plexus.

On the basis of anatomic studies, the author has worked out a safe and satisfactory technic for anesthetization of both the middle cervical and the stellate ganglions. The middle cervical ganglion is situated in front of the transverse process of the sixth cervical vertebra; the intermediate ganglion (superoexternal portion of the stellate ganglion) lies in front of the transverse process of the seventh cervical vertebra. Complete sympathetic block is usually obtained with anterolateral injection against the transverse process of the sixth cervical vertebra. With the patient in the upright position, the anesthetic diffuses downward in the prevertebral tissue and thus produces a block of the stellate ganglion. If the stellate ganglion is not sufficiently anesthetized, a second injection is made at the transverse process of the seventh cervical vertebra. No serious complications or accidents have been observed with this method.

The author has successfully employed his technic in the following conditions: angina pectoris, cerebral vasospasm, organic vascular disease of the upper extremity, Raynaud's disease, causalgia and painful edema of the arm following radical mastectomy. LIST, Ann Arbor, Mich.

TREATMENT OF EPILEPTIC PATIENTS WITH A COMBINATION OF 3-METHYL 5, 5 PHENYLETHYL-HYDANTOIN AND PHENOBARBITAL. ANTHONY E. LOSCALZO, J. Nerv. & Ment. Dis. **101**:537 (June) 1945.

Loscalzo reports the use of a new hydantoin derivative, 3-methyl-5, 5-phenyl-ethyl-hydantoin, in combination with phenobarbital in 17 cases of epilepsy of unknown origin. Each tablet contained 0.02 Gm. of phenobarbital and 0.1 Gm. of the hydantoin derivative. Of the 17 cases, 15 were of the so-called idiopathic type, while the remaining 2 were probably on an organic basis. One to 6 tablets were taken by each patient daily, the average dose being 3 tablets daily. In 12 cases a notable reduction occurred in frequency of attacks, and the total number of attacks was reduced by approximately 60 per cent. An improved mental and emotional status was noted consistently. The incidence of side effects as compared with that for sodium diphenylhydantoin was strikingly low, there being only 2 instances of gum hyperplasia and no ataxia, vomiting, dizziness or diplopia.

CHODOFF, Langley Field, Va.

ELECTROSHOCK THERAPY. SAMUEL RAMIREZ MORENO, Rev. mex. de psiquiat. **10**:3 (Jan. 1) 1944.

The author reports experiences with electroshock therapy of 87 patients, 48 men and 39 women. The course of treatment was completed for 81 patients. The maximum age was 60 and the minimum 8, with an average of 30.9 years, 28 for the men and 34.5 for the women. A total of 1,191 treatments were given, in 701 of which grand mal seizures and in 490 petit mal seizures, were induced. Petit mal seizures were much more frequent in men than in women. The maximum number of treatments given to a patient was 31. The largest number of grand mal seizures in any patient was 27. The male patients were given an average of 12.9 treatments and the female patients 14.3 treatments. There were 40 complete remissions among 81 patients, 22 in men and 18 in women. There were 30 partial remissions, 15 in men and 15 in women. There was no improvement at all in 11 patients. Three patients had a recurrence after completion of treatment. Many of the patients could not be followed. Sixteen patients (9 men and 7 women) were treated inadequately, for various reasons. The only accidents during treatment were 3 cases of prolonged apnea and 1 case of dislocation of the mandible; in a few instances there were mild injuries to the lips. Among 54 schizophrenic patients there were 24 complete remissions (44 per cent), 41 partial remissions (30 per cent) and 9 failures (17 per cent). Among 14 patients with stupor syndromes (*síndromes confusionales*) 11 had complete remissions and 3 incomplete remissions. Of 6 patients with manic-depressive psychosis, 3 had complete remissions and 3 partial remissions. In 23 patients with an illness of less than six months' duration, there were 15 complete and 8 partial remissions; in 9 patients with an illness of six to twelve months' duration, there were 7 complete remissions, 1 partial remission and 1 failure. In 20 patients with a history of one to three years' illness, there were 7 complete remissions, 9 partial remissions and 4 failures. In 23 patients with an illness of more than three years' duration, there were only 7 complete remissions, 10 partial remissions and 6 failures. For 6 in the series of 81 patients the duration of illness was unknown. In 65 patients of this series insulin hypoglycemia was induced in addition to the electroshock therapy. This unquestionably contributed to the favorable results. Metrazol was also given to 4 and malarial therapy to 3. Curare was used for only 6 patients.

SAVITSKY, New York.

ELECTROSHOCK THERAPY: TECHNIC AND INDICATIONS. ARTURO VIVADO and CARLOS NUNEZ SAAVEDRA, Rev. de psiquiat. y disc. conexas **9**:7, 1944.

The authors report on 1,116 treatments given to 75 patients in a hospital in Chile. The first patient was treated in June 1943. The average current was

120 volts, given for 0.1 second, the voltage varying from 60 to 150 and the time from 0.1 to 4 seconds. Two patients with cardiac lesions withstood the therapy well. The seizures were considered to be more severe than those induced with metrazol. There were no fractures. Pain in the region of the right shoulder was reported a few times; there were readily reducible dislocations of the jaw in 2 instances. Of the patients with acute schizophrenia 76 per cent recovered, and of those with the chronic form 22 per cent. All 6 patients with simple schizophrenia failed to respond. Four of 5 patients with acute catatonia recovered; 3 with hebephrenia who were ill less than seven months recovered completely, but only 2 of the patients with chronic hebephrenia responded. Only 2 of 15 patients with chronic paranoid schizophrenia showed improvement, and the condition of 3 of 6 patients with the acute form cleared up. Of the patients with manic-depressive psychoses 87 per cent improved. The best results were obtained with the involutional psychoses (100 per cent recovery). More treatments were necessary for schizophrenia than for manic-depressive psychosis.

SAVITSKY, New York.

Muscular System

DYSTROPHIA MYOTONICA (STEINERT'S DISEASE): IMPORTANCE OF CATARACT AND DISTURBANCES OF METABOLISM; THERAPEUTIC EFFECT OF VITAMIN E. A. FRANCESCHETTI and R. S. MACH, Helvet. med. acta **11**:887, 1944.

Franceschetti and Mach describe 3 personally observed cases of dystrophia myotonica and stress the importance of cataract in the differential diagnosis. In the atypical forms of Steinert's disease only the presence of a cataract permits a definite diagnosis. The biomicroscopic examination of the crystalline lens is indispensable for the differentiation of myotonic dystrophy from other myopathies, particularly from congenital myotonia. The appearance of creatinuria after an aminoacetic acid tolerance test is of great diagnostic value in that in cases of progressive muscular atrophy, congenital myotonia, myasthenia gravis and the muscular atrophies of the Charcot-Marie type creatinuria nearly always appears after the test but neither spontaneous nor induced creatinuria is necessarily present in myotonic dystrophy. The authors observed the favorable effect of vitamin E in a case of myotonic dystrophy, as well as in a case of idiopathic muscular dystrophy (Erb's disease). The therapeutic effect of vitamin E on the muscular function is accompanied by improvement in the creatine metabolism. Myotonic dystrophy has a special place in that some of its symptoms indicate a lesion of endocrine glands, while others indicate a nervous origin. It is possible that both these factors are involved.

J. A. M. A.

Society Transactions

NEW YORK NEUROLOGICAL SOCIETY AND NEW YORK ACADEMY OF MEDICINE, SECTION OF NEUROLOGY AND PSYCHIATRY AND SECTION OF PEDIATRICS

Lawrence S. Kubie, M.D., *Chairman, Section of Neurology and Psychiatry, Presiding*

Joint Meeting, Jan. 8, 1946

Relation Between Maturation and Acculturation. Dr. Arnold Gesell, New Haven, Conn. (by invitation).

The individual comes into his racial inheritance through processes of maturation. He comes into his social inheritance through processes of acculturation. These two sets of processes operate and interact in such conjunction that it is impossible to separate the two components. Racial man is extremely ancient. Cultural man is extremely recent. The processes of maturation in the individual perpetuate the evolutionary past and mediate the evolving future. Maturation is the net sum of the gene effects, operating in a self-limited life cycle.

The embryology of behavior can be envisaged in terms of posture and postural sets. All vertebrates strike attitudes. The morphogenesis of the tonic neck reflex in man illustrates the mechanism of maturation. At an early fetal age (11½ weeks) the characteristic habitus of the fetus is symmetric. The fetus manifests a bilaterally balanced attitude, in which the hands may simultaneously approximate toward the midline. This is called the symmetrotonic reflex, which in time gives way to an asymmetric habitus. I have identified and photographed a well defined tonic neck reflex in a prematurely born infant at the fetal age of 28 weeks. This reflex holds strong sway during the first eight weeks after normal, full term birth; at the age of 12 weeks it is less conspicuous; at 16 weeks it is in transition, and at 20 weeks it is in eclipse, for the head is then held predominantly in the midposition. In another two months the symmetric bilaterality, in turn, gives way to new unilateral patterns: one-handed reaching; one-handed manipulation and hand to hand transfer, and, ultimately, to well defined dextrality or sinistrality. Here is a clear example of almost periodic, interweaving maturation, now of symmetric and then of asymmetric behavior forms, with corresponding shifts in sensorimotor attitudes—a reciprocal, spiral-like interweaving, which prevails at all levels of the growth cycle and which may well have implications for the comparative study of varying cultures.

The tonic neck reflex and related postural sets have left their impress on many of the tools of man and on the manner in which he wields them. Note how unidexterity and asymmetric stances figure in the use of spear, harpoon, shovel, rifle, fencing foil, violin and golf stick.

It is interesting to learn that Sinanthropus pekinensis, as early as the second glacial age, a few hundred thousand years ago, was mastering the vertical and the horizontal movements of his even then archaic motor system. He flaked boulders into heavy chopping tools and into finer scrapers; and the manner of his flaking suggests that he was right handed and perhaps, by the same token, vocally articulate.

Monozygotic twins also exemplify mechanisms of maturation. Using the method of co-twin control, we have investigated the growth careers of twins T and C over a period of seventeen years, from early infancy to adolesence. Twin T was subjected to hundreds of hours of specialized training designed to improve her motor coordinations in stair climbing, her prehension and manipulation, her constructiveness in cube play, her vocabulary and other associated behavior attain-

ments. There is no evidence that these specialized experiences have added either a cubit to her mental stature or a basic component to her individuality. To this day, the twins remain remarkably, almost indistinguishably, alike. Training cannot readily transcend maturation. The growth careers of the twins have been strikingly parallel.

Certain disparities, however, in the behavior traits of twins T and C have great significance, because we were unable to trace these disparities to any cultural or psychogenic factors or to the influences of differential training.

Subtle, but deep-seated, differences in sensorimotor attitudes finally express themselves in attentional characteristics. The following double column sums up basic differences in the behavior equipment of twins T and C, adapted from Gesell and Thompson (Twins T and C from Infancy to Adolescence: A Biogenetic Study of Individual Differences by the Method of Co-Twin Control, *Gen. Psychol. Monogr.* **24**:3-121, 1941).

Attentional Characteristics of Twins T and C

	Twin T	Twin C
Initial pick-up	Prompt	Deliberate
Fixation	Intense	Relaxed
Focalization	Sharp	Diffuse
Other characteristics	Decisive	Roving
	Discrete	Confluent
	Delimited	Sensitive to context
	Selective for details	Comprehensive
	Specifically alert	Generally alert
	Adaptive exploitation	Personal-social elaboration
	Less social initiative	More social initiative

We do not wish to imply that the culture does not imprint its stamp through its molding apparatus. But, once more, the primary role of maturation must be noted. When human behavior is organized in a cultural milieu, there is almost an infinitude of available environments; the organism selects from this infinitude in much the same way that a living cell may or may not select potassium from a fluid medium. The structure of the organism, whether conceived in terms of bioelectric potentials or particles of stereochemistry, is attuned to what it selects and averse to what it rejects. This accounts for the primary molding power of innate sensorimotor attitudes and of the psychomotor attitudes which they induce.

Cultural Patterning of Maturation in Selected Primitive Societies. Dr. Margaret Mead (by invitation).

Moving pictures of the Balinese and of the Iatmul tribe in New Guinea were shown contrasting the methods of handling, bathing, feeding and carrying of very young children. Material from other primitive cultures supports the hypothesis that handling the child as a limp part of the mother's body, so that it learns to move as she moves and when she moves, is congruent with a passive type of behavior, while handling the child as if it had a separate will of its own, and giving it an opportunity to assume states of tension separate from and contrasting with those of the maternal body, is associated with more assertive types of behavior. In later life the Balinese tend to use only such parts of their bodies as are relevant, fitting plastically into an action context, while the Iatmul, especially the males, tend to mobilize their whole bodies, even for small acts. The partial bodily involvement of the Balinese is accompanied by a lack of "attention" to the task in hand, while the Iatmul must mobilize his full interest if he is to do any piece of work. While it is improbable that any single item of child rearing can be credited with causality, the whole array of items can be seen as a means of communication between parent and child, within which the child establishes—through deuterolearning—an expectation about the nature of the world and a habit of responding to it. Analysis of the details in two contrasting systems such as these should provide a framework for the identification of significant cultural *units* of behavior, supplementing Dr. Gesell's analysis of maturation patterns.

Environment Vs. Race—Environment as an Etiologic Factor in Psychiatric Disturbances in Infancy. Dr. René A. Spitz (by invitation) and Dr. Kathe M. Wolf (by invitation).

An experimental approach to the question whether racial differences exert an influence on development—mental, social and otherwise—was attempted. With the purpose of excluding variables usually encountered in such investigations, the sample was limited to a nursery in which Negro and white babies were reared together under identical conditions. Eighty-seven Negro and 178 white babies were observed from birth to the end of the first year. The developmental quotients of these infants were established at monthly intervals, as well as the quotients for six different sectors of the personality, namely, perception, body mastery, social behavior, learning, handling of material and intelligence. A comparison of the averages of the developmental quotients for the white children with those for the Negro children in the single months resulted in curves with insignificant differences except for the eleventh and twelfth months, in which the Negro children showed a relative retardation of about 10 per cent as compared with the white children.

A comparison of the average quotients of the white and the Negro children in the six different sectors of personality at monthly levels showed that the variations observed in the Negro children (better than average body mastery, slightly poorer than average development in the other sectors) simply exaggerated the same findings for the white children in this nursery. A scrutiny of the environmental factors disclosed a negative selection operating to the detriment of the Negro children admitted. These variations, therefore, could be attributed to the influence of environmental factors. This makes it probable that, if not the whole, at least a large part of the difference between the developmental quotients of white and Negro children encountered in this sample was attributable to environmental influences.

In a second experiment, this group of children belonging to mixed races was compared with a group of 61 children also belonging to mixed races. In the case of the latter, however, a completely different environment was selected. The first group was reared by their mothers in a nursery; the new group was also reared in a nursery, but without mothers, in conditions of emotional starvation. Although the developmental quotients for the two groups were approximately equal during the first three months, the difference in the average developmental quotients between the first and the second group at the end of the first year was startling, amounting to nearly 30 per cent, placing the children of the second group at the level of high grade morons. By the end of eighteen months this difference had increased to over 50 per cent, placing the children of the second environment in the category of imbeciles.

Conclusion: The consequences of racial difference on development, both of a physical and of a mental nature, appear to be insignificant in the course of the first year of life. The consequences of environmental differences in the same period, when they are of an emotional nature, are extremely far reaching.

DISCUSSION ON PAPERS BY DRS. GESELL, MEAD AND SPITZ AND WOLF

Dr. Gregory Bateson (by invitation): From all these papers there is an important lesson for anthropology. I shall state this as it appears to me as an anthropologist and then consider what its bearing will be in the fields of psychiatry and pediatrics. For the last fifteen years we anthropologists have been trying to demonstrate and analyze the uniformities and homogeneities of the cultural matrix in which the child grows up and in which the adult lives, and we are now able to demonstrate this factor fairly well in the simpler, nonoccidental cultures. We hesitate on the word "homogeneity" when faced with such heterogeneity as exists in New York city, but in part we get out of the difficulty by saying that the fact of heterogeneity is an element which affects every person in his environment. Every baby in New York is born of parents who know

that other parents down the street are bringing up their babies in a way very different from theirs.

For a long time we were inclined to suggest that the individual is in some sense standardized by the cultural matrix in which he lives. I think the next step is to discard the notion of the standardization of the individual in terms of his culture and ask what types of persons will be differentiated and made more deviant by any particular cultural matrix.

With respect to Dr. Gesell's suggestion: If a culture insists on teaching a given item or habit at a given stage, that culture will sort out and push into deviant character formation any child whose growth deviates from the local norm in its sequence or duration. The deviant child will be compelled to learn things at a difficult period while a majority of children are learning them at an easy period, or vice versa. Similarly, with the twins T and C: Scientists are familiar with the sorting of optical isomers by bringing them against other optically active substances. The two optical isomers can be separated by setting up a chemical reaction in which the mixed isomers react with another optically active material. Something of the same sort has probably happened to the twins, one evidently left handed and the other right handed. They were probably handled by predominantly right handed people, and this experience must necessarily have had a different and special quality for the left handed twin. The difference between these twins was essentially a matter of certainty and precision and care in movement and locomotion, such as might well be caused by differential muscular experience.

An entirely new facet on the cultural matrixes will be available when a given culture can be described in terms of the deviants which that culture creates in a genetically mixed population.

DR. MARIANNE KRIS: I speak as a clinician, and thus as one who relies on impressions gained outside the experimental situation. I am greatly impressed by the exactitude and by the stimulating nature of the data presented in all three papers. Two of these papers refer to a context familiar in a way: The reports of Dr. Mead and Dr. Spitz deal with the unit with which we clinicians are concerned in our daily work: that of child and mother.

During the last few years we have come to appreciate ever more the closeness of this relation. I should like to remind you of Dr. Ribble's and Dr. Fries's recent contributions. My own material consists of persons of lower and upper middle class homes, who turn to the analytically trained psychiatrist, directly or through the social agencies, for prophylactic guidance in child rearing or for advice when disturbances have set in. From this material it is evident that the closeness of mother and child outlasts the early phases of development discussed in these papers. It is not limited to the first and second years of life but lasts, with normal and abnormal children, sometimes well into the period of latency. This closeness becomes more apparent with the appearance of disturbances or in critical phases of the child's life. Let it not be forgotten that no child in present day civilization grows up "smoothly"; normalcy is not a linear development but is full of tempestuous ups and downs. For instance, a child of 7 still reflects the mother's starvation fantasy in its refusal to eat; the child will eat when away from the mother, even just for mealtime. A child of 5 cannot tolerate the separation from the mother and apparently does not want any contact with other children, in order to stay with her. In reality, it is the mother who keeps the child for herself; and while she urges the child consciously, verbally, to play with others, the child in clinging to the mother, reacts in tune with the mother's separation anxiety; this could be observed in the consultation room and was evidenced by the fact that when the child went out to the park with the maid he could readily associate with playmates. A little girl in her second year of life is well adjusted, active and independent and behaves appropriately to her age when she is with her mother. But the nurse, who since the child's birth has taken her over for several hours daily, loves babies only. Whenever the child is

with the nurse, she acts more passively, more dependently, like a baby. These superficial examples illustrate that child behavior can be directly patterned by the personalities of mother and mother substitute. What in these cases appears as a transient influence on behavior, bound up with the presence of the mother or nurse soon gains permanent influence in these and other areas of child rearing. Through lasting identification with the primary objects the process of acculturation takes place.

In clinical observation the pink and the blue are constantly mixed. Nature and culture ordinarily appear as one.

The exactitude and the wealth of Dr. Gesell's data have always been impressive to me so far as the development of bodily functions is concerned. But in regard to social and emotional development one is faced with a greater complexity. Where processes of growth affect interpersonal relationships, of whatever kind, social learning plays its part. Those of Yerkes' chimpanzees who never lived in a group and never saw a cub being trained were inapt as mothers; those who had lived with the group and had seen cubs being reared knew their duties as mothers well.

Dr. Mead's material throws ample light on these points. The few examples she showed are fascinating even to those who have no complete picture of Balinese or Iatmul culture. May I point to a detail of the material (in order to elicit a reaction from Dr. Mead in the discussion)? Dr. Mead reports that the Balinese eat snacks freely and drink freely but are embarrassed and hide their faces from each other when eating solid food. "They are embarrassed," said Dr. Mead once, "as when they defecate." In the admirable moving picture, we saw that prechewed solid food is forced on them in infancy. Such gestures as the mother makes may well be experienced by the child as coercion of some kind. It may be remembered that coercion also usually plays a part in toilet training. Might it not be that the Balinese child reacts to the coercive handling? Coercion might indicate a forbidding attitude of the parents, and thus in the Balinese the act of eating solid food may have become associated with something forbidden, embarrassing; of course, this need not be the only, nor even the main, source of the embarrassment.

My question to Dr. Spitz is linked with a similar problem. In his conclusive presentation he stated that the Negro babies were more advanced in body control than the white ones. He traced this to the difference in the behavior of the Negro and the white mothers in the institution. In the nursery which I once had the privilege of visiting with Dr. Spitz, all the babies seemed to be restricted to their cots. No crawling, creeping or walking was permitted, except within the cot itself. Might not this restriction be more severe when it affects babies more advanced in motor development? Might it not influence, in turn, their social development in the second half of their first year and thus partly account for its relative retardation?

May I conclude with a suggestion? One has much to learn from the methods of systematic observation, of which such impressive examples have been presented here. Anthropologic field work in occidental culture, integrating the approaches which are seen to be at work, might in the future permit the formulation of hypotheses on more exact data than those on which they have usually been derived.

Dr. Heinz Hartmann, Canajoharie, N. Y.: If a psychoanalyst is asked to take part in a discussion on maturation and acculturation, or development, I suppose he should state specifically what the analytic approach can contribute to a solution of the problems involved. This I cannot possibly do here, but I shall try to say something in the time allotted me.

There is, to begin with, the attempt to determine the phases and situations that can be considered crucial in human development. Take, for example, Dr. Spitz's significant comparative study of white and Negro infants. Dr. Spitz avoided a probably wrong conclusion (predominance of racial characters) and found a probably right one by introducing a hypothesis derived from clinical

analytic experience, and based on a genetic point of view: the hypothesis that a great variety of developmental characters in the child (such as body mastery and handling of materials) can in part be traced to his emotional relationship with his mother or her substitute. The same hypothesis is applicable to Dr. Mead's interesting work on the handling of children in various primitive cultures. One may say that the developmental importance of many childhood situations, typical and atypical, has been ascertained by the retrospective method of analysis, even in cases in which it could not be traced by the direct observation of the child, for reasons I shall not discuss here. Think, for example, of the vicissitudes of the child's oral needs, of the role of frustrations in the period of toilet training, of growth and development at the phallic level and of aggression.

Another characteristic of the analytic approach is the pursuit, to as great extent as is possible, of continuous developmental trends under specific and controlled conditions. A great number of childhood situations of incisive significance for the formation of the adult personality have—if I may borrow a term from genetics—a low "probability of manifestation." A girl at the age of 3 may have wished that her pregnant mother would die in giving birth to the sibling. At the age of 25, being pregnant, the woman may develop fears of dying during childbirth or feeding disturbance. The early childhood wish or situation will have been repressed. No nonanalytic method will be able to unearth it or to disclose its vicissitudes in the period between. The retrospective method of analysis, however, enables one to gain an understanding of the continuity of the development. In order to define correctly the respective significances of maturation and environment, the inclusion of such latent factors is necessary—at least in certain sectors of human development.

Another approach has been presented by Dr. Gesell with great lucidity. His co-twin control method is perhaps the most exact one available in this field, though its applicability is unfortunately limited. The same also holds true to a certain extent for the comparative study of monozygotic twins in general. If an analyst could get hold of analogous material in an analogous setup, his selection of variables would probably be different. Briefly to characterize the differences in approach, both being necessary, of course, I should say that in Dr. Gesell's research one has the study per se of what are called ego mechanisms; in the other approach, analysis, the investigations center around the child's needs. Rather than subject one of the twins to special training in prehension or manipulation, for example, the analyst would (without going so far as Patagonia) change the emotional environment, or the duration of the nursing period, or the attitude toward sexual play, or aggression, of one twin; he would expect—rightly or wrongly, a matter to be tested—differences in the later behavior of the twins to be noticeable.

What Dr. Gesell has said about gradients of growth partly conforms in a rather striking way to analytic findings. I am thinking of his comments on shame, on the ambivalent attitudes toward commands, on obedience to rules, on doubt, in what is called the latency period. In some instances the analyst could probably explain typical sequences or trace individual deviations from the gradients (such as those in the myth of Santa Claus). He might also be able, in certain cases, to evaluate the prospective importance of these deviations and eventually to check his prognosis, as Dr. Spitz did in a paper which he recently published, though he would not expect a simple correlation between any one such factor and the later behavior of the subject. (Dr. Mead is quite right in what she has said against any single causative factor.) He has become used to the fact that in most cases a rather complicated analysis of a great variety of factors is necessary.

The gradients of growth indicate not only average maturation but also average environment. So do the typical phases of growth which psychoanalysis describes. It is true that Freud discovered a category of environmental factors the influence of which on development had not been previously understood. The concept of the libidinal phase, for instance, is defined not only by these factors but by the process of maturation. An experience which may be meaningless for a child

of 2 may be traumatic for the same child at the age of 3. There is a specific vulnerability to specific experience at each level of development. Crucial situations which have influence on the child's development may be chiefly related to maturation or to environment; as a matter of fact, in the typical phases of conflict, as they are called, maturational changes and typical, decisive environmental influences largely coincide.

Though maturation is based on constitutional factors, its actual course is not necessarily rigidly defined in this way. As in the case with other factors in the anlage, a certain plasticity in its manifestation has to be accounted for. The investigation of the factors that may hasten or retard it is, in analysis, of special interest. Of equal interest are the steps by which the potentialities of the anlage become actualized.

Except by the twin methods, one cannot study maturation as an isolated factor and environment as an isolated factor and then put the two together. Also, as a rule, cultural patterns have to be broken down into specific and psychologically significant elements before they can be correlated with the problems of growth, as Dr. Mead of course knows better than I. On the other hand, the developmental implications of the growth patterns have to be clarified before their possible cultural importance can be evaluated. If, however, one makes a comparative study of childhood histories, based on the analysis of hundreds of concrete situations and over long periods of time, and if these data are elaborated with respect to both maturation and cultural patterns, one should gradually acquire relatively clear insight into a variety of actual relations between these factors. It is then evident that, as Dr. Gesell said, a selection of cultural environments can often be traced to factors of maturation, but a selection takes place also in the other direction; that is, individual tendencies are strengthened, repressed and displaced in accordance with cultural patterns.

I have tried to indicate some points at which analysis could contribute, or actually has contributed, to solving the problems discussed by these three stimulating papers. Today there is a considerable sphere of agreement as to some main features of human development. As to other features, there is an interesting correlation between the emphasis on various factors and the different methods of study. In the study of a particular phase of growth, for method, one method will make facts apparent or give them importance, while the other leaves them in the dark or lets them seem unimportant, and vice versa. This merely emphasizes in other words what Dr. Gesell said in the beginning: that at the present stage of factual and methodologic insight, given the incompleteness of any single approach to the problem, the conjunctive contributions of all of them, and their mutual checking, are necessary.

Dr. Arnold Gesell, New Haven, Conn.: I wish to express my appreciation of the comments made and of the illumination that has come from these related fields of study. In this work one is dealing with facts and with panels; there is no one method of investigation, but there is the integrity of the individual. Perhaps the various investigators can meet on common ground in some integrating psychosomatic concept which recognizes that morphology is the fundamental problem of behavior.

Dr. René A. Spitz: I wish to thank the discussers for their illuminating and stimulating comments. In connection with Dr. Bateson's problem of the types of persons who will be made more deviant by a given condition, he will have to take into consideration, on the one hand, a concept introduced by Dr. Gesell, that of maturation, and its relationship, on the other hand, to that of certain environmental factors becoming effective. To give him the simplest description of this relationship, and the most brutal one: Separation from the mother, about which I have said little here, and which I intend to present in more detail, can be completely and irreversibly destructive if it happens during the first year; it can be reversible if it happens during the second year. This is a problem of maturation, though I should call it maturation not of the bodily

type but of the "ego maturation" type. In this connection, I want to answer Dr. Kris's question also. The baby's restriction to the cot is a problem which I had intended to discuss, but the shortness of the time did not permit. It is true that these children are restricted to the crib during the first year; the curious fact is that their bodily development is not hampered by this restriction; if anything, it is better than average because they climb in a manner in which children in the first year cannot climb. The restriction seems actually to present a stimulus. However, it probably has a certain influence in the sphere of intellectual development; whether it is an influence in social development is a question which certain investigations which I am now conducting will clarify.

PHILADELPHIA PSYCHIATRIC SOCIETY

Samuel B. Hadden, M.D., *President, in the Chair*

Regular Meeting, March 8, 1946

Psychiatric Characteristics of Patients with Venereal Disease. Dr. Morris W. Brody.

While in the military service, I was afforded an opportunity to make a psychiatric study among men who had contracted venereal disease. Part 1 of this paper concerned a questionnaire submitted to these men. As a basis for comparison, a similar study was conducted on men in the medical and surgical wards of a general hospital and on a third group of men hospitalized because of psychoneurosis.

The man with venereal disease has certain characteristics which distinguish him from members of the other groups. He is more often colored; he is of average intelligence; he is younger, and he is more often single. He is more unrestrained, is readier to take chances and is more easily influenced. He drinks a little more as a civilian and has been arrested more frequently. He does not adjust so well to Army life, receiving more courts-martial and company punishments. He is chiefly distinguished by being more lascivious than the average person. He begins his sexual life earlier as a civilian, indulges more frequently in illicit sexual relations and more often visits professional prostitutes. As a soldier overseas, he resumed his heterosexual experiences sooner and indulged more frequently. Sexual intercourse is a more important factor in his life, and he shows less choice regarding the women with whom he cohabits. He less often selects the women, but, because of his libidinous ways, he is readily solicited by them. After he has contracted venereal disease he is not deterred from exposure to fresh infection. The psychoneurotic patient, on the other hand, is most inhibited in his behavior. There is a more striking difference in behavior between the colored control group and the colored venereal group than is shown between the corresponding white groups.

Part 2 of the paper dealt with the reasons that men expose themselves to the risk of contracting venereal disease. In part 3, the relation of mental sickness and the patient with venereal disease was discussed. Part 4 dealt with (1) the teaching program in the Army regarding the control of venereal disease, and (2) suggestions regarding the control of venereal disease.

DISCUSSION

Dr. Calvin Drayer: I was present at the previous presentation of Dr. Brody's paper, in Naples. It is quite true that some of the points he discussed brought forth considerable protest. Nevertheless, the investigation has been carefully conducted and throws light on a delicate subject, which is by no means a problem in the Army only. It has been brought into prominence by the military authorities, as Dr. Brody has described. Briefly, the important point which Dr. Brody made

is that one is concerned not so much with abnormal persons as with abnormal situations. In that respect, of course, the problem of venereal disease is somewhat similar to the more widely discussed problem of combat reactions, in which a highly abnormal situation is involved. In both these problems one is faced with what to do about it. Dr. Brody, unfortunately, did not discuss some of his recommendations in reading the paper. I say unfortunately, for they are, I think, sound, and I should like to discuss some of the basic elements in them. They may be classified as positive and negative measures. The recommendation he made not only includes the elements of patriotism but appeals to men's loyalty to the home situation. The negative, or restrictive, measures include the clean-up campaigns. As psychiatrists, we tried to maintain our loyalty to psychiatric concepts, but I think we were all enlightened by finding that many of the restrictions worked which we would have regarded theoretically as too severe. Unless some real obstacles are set up, the positive effort is not going to work very well. An illustration of this was the experience in the early part of the Italian campaign. General Clark, who was much concerned about the problem, issued a number of severe directives. We all wondered what the result would be, since there were serious threats to morale at that stage of the campaign. A little later we captured a directive from Kesselring to the German troops, which was practically a duplicate of General Clark's. There was no question that the Germans had reasonably good morale at the time. In other words, a positive appeal certainly had its place, but setting up of restrictions could not be avoided. One cannot overcome completely a person's needs and normal drives by superimposing ideologies even as strong as those of the Nazis, and effective restrictions ultimately paid dividends in the form of lowered rates of venereal disease.

The situation in which the patients whom Dr. Brody studied became infected was unusual in many ways. Venery has a long, and one might almost say an honorable, tradition in the area about Naples. Hannibal wintered his troops there, and the Romans sent women down who succeeded very well in their mission of demoralization. Syphilis was first recognized there in the fifteenth century. I have heard it said that the gonococci there were fully 50 per cent larger than in any other part of the world! We had the opportunity to observe very normal men exposed to very abnormal pressures.

To come back to the original point, we soon found that until restrictions could be established the rates of venereal disease were not reduced. It was a temporary situation, and resort to restrictive measures was certainly the way to handle it in Naples.

Dr. Leonard H. Taboroff, New York: I was interested in the paper because of my experience as temporary venereal disease control officer with an American Infantry Division. My tenure was short and immediately followed the invasion of Cebu, P. I., in April 1945. My colleagues and I thought our rate was very high when it reached 55 per 1,000 per annum. The rate on Guadalcanal and Bougainville had been zero for two and one-half years. The base and the headquarters troops had a much higher rate than the combat infantry. I could not make a statistical study at the time, but in talking with the men I obtained an impression quite similar to Dr. Brody's statistical findings.

Dr. O. S. English: A paper like this makes one wonder how more can be done to prevent the high incidence of venereal disease. I was interested in Dr. Brody's opinion that the best campaign is to try to inculcate into the men an attitude of total restraint. It seems like a great undertaking and one wonders whether such a plan could be carried out successfully. It could, of course, be done more successfully if every one were behind it; but people are divided on their opinion as to the need for sexual expression. Those expressing themselves against sexual indulgence are secretly for it, and those speaking of liberality are really not ignoring the value of restraint. The solution would have to be one of more intensive work on the two extremes. Either more campaigning should be done for abstinence, or the need for sexual outlet should be accepted and some means for

control of venereal disease set up. The hardest thing for people to think about is the need for sexual outlet. The figures show that even in peacetime the figures for extramarital and premarital intercourse increase with each decade. If this is true in peacetime, it is certain that the rate will be much higher in war, as the man then feels more justified in indulging himself in sexual gratification. I wonder whether it is possible to get to the point where the spread of venereal disease can be controlled; I wonder, also, whether it is possible to help the venereal program by a program of abstinence.

Dr. Joseph M. Foley, Boston: Another method of control to keep down the rate of venereal disease was tried. A circle of military police would be drawn around an area that was involved in the industry, so that anybody coming out of that area was required to submit to prophylactic treatment. This caused great difficulty, since innocent parties were frequently apprehended. While serving with the Army, I was in close proximity to a group of 500 Navy men for one and one-half years. During this time only 4 cases of venereal disease developed in this group, even though lectures on venereal disease were never given. A disturbing thing about the venereal disease lectures in the Army is that the same points are constantly repeated and the lectures all follow the same pattern.

Dr. Samuel B. Hadden: Has Dr. Brody noticed any correlation in the rise and decline of the incidence of venereal disease with the visits of the U. S. O. shows?

Dr. Morris W. Brody: That is an interesting question. I do not know the effects of variety shows on the rate of venereal disease. However, the venereal disease control officer in Naples had the idea of getting together a group of beautiful Italian prostitutes, dressing them in lovely clothes and presenting them in a short variety show to groups of soldiers. After the show the soldiers were told not to be fooled by appearances, since all these beautiful women had venereal disease. The soldiers, however, were not impressed and sought dates with these infected women. The soldiers, furthermore, showed real hostility toward the venereal disease control officer, who they thought was fooling them and treating the girls in an ungentlemanly manner. The soldiers, on the other hand, were impressed and easily fooled when a man blinded by cataracts and badly crippled with rheumatism was presented to them to illustrate the last stages of syphilis.

Physiologic Pathology of Schizophrenia and Manic-Depressive Psychosis.
Dr. Seymour DeWitt Ludlum.

Various psychologic modalities were plotted as physiologic gradients in a number of cases of schizophrenia. The graph taken during the illness was contrasted with the graph on recovery, thus emphasizing the physiologic change which accompanies the return of normal mental functions. Evidence was presented to the effect that the physiologic gradient of the recovered schizophrenic patient is almost identical with that of the normal type of the "immature" personality, frequently referred to as the constitutional psychopathic inferior personality.

Subsequently, the physiologic findings for the manic-depressive psychosis were presented by the same method of analysis. The physiologic symptoms are those of regression, a falling back into the physiologic gradient of the "immature," or the "constitutional inferior," personality, in which there is a lowered physiologic state which cannot produce orderly psychomotor responses.

As proof of the reversibility of physiologic symptoms, the graphs for recovered patients following insulin and electroshock treatment were presented.

It does not matter what etiologic emphasis is held—whether psychic or somatic—the mechanism remains the same and operates in the same manner. Compensation in relation to cardiac function is a term that means balancing of the forces—equilibrium. The functioning of the brain lends itself to similar concepts.

DISCUSSION

DR. SAMUEL B. HADDEN: Dr. Ludlum's exhaustive studies over many years have made a valuable contribution to psychiatry. All are familiar with efforts in the past to classify patients with mental illness according to their physical build and other physical characteristics. Dr. Ludlum points out a disturbance in physical chemistry associated with mental illness, and this observation may well be an initial step in the eventual alteration of body chemistry, with final restoration of normal mental function. Already, this type of study of the blood has been of practical value to manufacturers of biologic products. Through studies of the blood, such as Dr. Ludlum presents here, the ability of a horse to form antitoxic substances may be determined. I feel that eventually Dr. Ludlum's observations and studies will be integrated into a more complete understanding and treatment of the mentally ill.

DR. O. S. ENGLISH: I have always been interested in Dr. Ludlum's work. It seems to me that there is something here that should be checked psychologically in much the same way as Dr. S. J. Beck has done in a series of Rorschach tests on patients before they are given prolonged psychiatric treatment and repeated after-treatments. Also, his findings deserve correlative psychologic study, in the manner of Benedek and Rubinstein, who studied psychologic, emotional curves of patients independently of those investigators who are doing physiologic work on activity of the ovarian hormone. I feel that if these patients were studied over a long period the physiologic changes would show a sensitivity which could be correlated with the emotional state.

Some people assume that the manic-depressive temperament cannot be changed; others say that it can. The same is true of schizophrenia. I believe changes can be brought about through intensive psychotherapy which may prevent future attacks. These changes would probably bring about alterations in the chemistry and physiology of the body.

Dr. Ludlum has assured me that he would be interested in cooperating with any one who would care to carry out such a study with him. I wish I could arrange to do it myself, as correlations between psychologic and physiologic activity in mental disease are much to be desired.

DR. SEYMOUR D. LUDLUM: There are laboratories in which regular studies are carried out on the ability of horses to form antibodies. Some are nonreactors and cannot make diphtheria antibodies; others make too many. I want to make it quite clear that I do not think that these physiologic abnormalities are the cause of insanity. They are the soil in which curious mental reactions grow. Stress and strain can produce those changes just as well as infection.

PHILADELPHIA NEUROLOGICAL SOCIETY

Robert A. Groff, M.D., *Presiding*

Regular Meeting, March 22, 1946

The Meningeal Reaction Associated with Abscess of the Brain. DR. BERNARD J. ALPERS and DR. FRANCIS M. FORSTER.

This article will be published in full in a future issue of the ARCHIVES.

A Case for Diagnosis. DR. HELENA RIGGS and DR. CHARLES RUPP JR.

A white boy aged 11 years complained of backache and stiff neck, of three months' duration. Two weeks before admission to another hospital he fainted and complained of loss of feeling in his right arm. Within two days there developed weakness of all extremities and difficulty in talking and swallowing. The general

physical examination showed no significant abnormalities. Neurologic examination revealed a diminished corneal reflex on the right side; horizontal nystagmus; weakness of the palate, tongue and trapezius muscle on the right side, and nasal speech. The right arm was paralyzed, and the left shoulder was weak. The abdominal reflexes were absent; the knee and ankle jerks were diminished, and the plantar responses were normal. There was nuchal rigidity, and position sense was lost in the right leg. The spinal fluid showed 1 cell per cubic millimeter and a total protein of 2,040 mg. per hundred cubic centimeters. The rest of the examination of the spinal fluid revealed nothing abnormal. After eleven days he was transferred to the Philadelphia General Hospital, where the previous neurologic findings were confirmed. In addition, there were found papilledema of 1 D. in both eyes, weakness of all extremities and a bilateral Babinski sign. A roentgenogram of the skull showed no abnormalities, and three examinations of the spinal fluid revealed grossly bloody fluid. The course was afebrile but was characterized by several attacks of weakness, lethargy and cyanosis. The papilledema increased to 4 D.; difficulty in urination developed, and respirations suddenly ceased as preparations for a craniotomy were being made.

DISCUSSION

DR. SHERMAN F. GILPIN JR.: I may have seen this patient unofficially. Certainly, the case presented a diffuse picture in that there were evidences of choked disk, weakness in all four extremities and absence of tendon reflexes in the lower extremities. He had some sensory changes. There was a great increase of protein in the spinal fluid. The Guillain-Barre syndrome covers the picture as well as any other. Cases are described in which there is edema of the disk, and the condition is called Devic's disease, or neuroencephalomyelitis optica. I do not think of any better diagnosis than that. Many believe that this group of diseases is quite variable in the extent of the involvement. The condition is thought by many to be of virus origin. Perhaps confined to the roots at times, at other times it includes the peripheral nerves, and I feel quite certain it also involves the central nervous system in some cases.

DR. BERNARD J. ALPERS: I believe that the condition started with involvement of the cervical portion of the cord or of the medullary region, and I visualize a bilateral lesion in both the cervical and the medullary region. With a protein content of 2,040 mg. per hundred cubic centimeters, I should make a diagnosis of tumor of the posterior fossa which was projecting through the foramen magnum; or, if the blood in the spinal fluid means what it is supposed to, the patient might even have an aneurysm in that region.

DR. JAMES J. RYAN: I should like to take a chance on the diagnosis of a multiple vascular neoplastic process. I believe that the early picture might well point to a lesion in the high cervical region of the cord or the lower part of the medulla, and there is reason to believe that the vestibular apparatus was later involved, as well as the cortex of the brain. The picture then shows unmistakable evidence of gradually increasing intracranial pressure. I wonder whether the early evidence of a high protein content of the spinal fluid and the later grossly bloody fluid are not indicative of a vascular neoplasm in the first place, with the possibility of leakage later. I should be in favor of the diagnosis of multiple hemangioma or multiple hemangioblastoma.

DR. MATTHEW T. MOORE: Dr. Ryan has indicated several of the considerations which have come to mind. In 2 other cases the history was somewhat similar. One was that of a woman aged 28, married, who presented the symptoms of choked disk and headache and then signs of bulbar involvement. There was xanthochromic spinal fluid, with an extremely high protein content. She subsequently had an acute episode with bloody spinal fluid, and operation revealed a hemangioblastoma of the cerebellum.

The other case was that of a youngster aged 8 who presented bulbar symptoms over a period of almost a month and suddenly had vomiting, stupor and choked disk. The intracranial pressure was increased. The spinal fluid was xanthochromic

and then frankly bloody. Autopsy revealed an angiomatous lesion involving the ventral surface of the medulla. I should venture the diagnosis of one of the following lesions: (1) cerebellar hemangioblastoma, (2) tumor apoplexy or (3) rhexis of a hemangioma at the ventral surface of the medulla.

DR. FRANCIS M. FORSTER: So long as vascular lesions are under discussion, arteriovenous aneurysm should be considered. In a recent review, Worster-Drought described lesions extending along the brain stem from the posterior into the anterior fossa. Recently, my associates and I saw a hemangioma which lay outside the brain stem proper and extended from the middle into the posterior fossa. These lesions should be included in the consideration of vascular neoplasms for the sake of completeness, but they are so rare as to be curiosities.

Dr. FRANCIS C. GRANT: I believe that the patient had a mass lesion in the posterior fossa, either an aneurysm or a tumor.

DR. HELENA RIGGS: Autopsy revealed that the entire medulla and the upper cervical portion of the cord were replaced by tumor tissue. There were both old and recent hemorrhages into the tumor. Histologically, the tumor appeared to be composed of immature cells resembling polar spongioblasts, with astrocytes predominating in some areas. There were deposits of calcium within the tumor, and the intrinsic vessels showed endothelial hyperplasia to the point of obliteration of the lumen.

In an earlier similar case autopsy had been performed. A white boy aged 11 complained of headache and projectile vomiting of one year's duration. On admission to the Philadelphia General Hospital, he showed slight choking of both disks, lateral nystagmus, pronounced dysarthria, atrophy of the right side of the tongue and inconstant weakness of the external rectus muscle bilaterally. He could barely stand and tended to fall to the left. His gait was ataxic. The tendon reflexes were diminished, but no pathologic reflexes were obtained. No sensory loss could be demonstrated. Examination of the spinal fluid revealed a pressure of 400 mm. of water. The child died three weeks after admission, during a suboccipital craniotomy.

Autopsy revealed gross lesions similar to those in the present case. Histologic examination showed that the tumor was composed of large fiber-forming astrocytes with voluminous cell bodies. Deposition of calcium and proliferation of vascular endothelial cells were also present.

Recent Advances in Treatment of Epilepsy, with Particular Emphasis on Use of Tridione. DR. H. HOUSTON MERRITT, New York (by invitation).

Research in epilepsy in the first two and one-half decades of this century was mainly directed toward the discovery of the cause of the disease. All means available to medical science were used to study patients afflicted with seizures, with the hope of finding some deviation from normal which would explain the seizures. These studies contributed greatly to knowledge of the disease but, with few exceptions, gave no new approach to therapy. In 1936 Dr. Tracy J. Putnam and I began a different approach to the problem. Using a new method of inducing convulsive seizures in animals, we made a systematic search for new anticonvulsant agents. This search had two aims: to discover a more efficient chemical for the prevention of convulsive seizures in man and to determine whether there is any constant structural configuration in the more effective anticonvulsant compounds. From the latter, it might then be possible to draw indirect conclusions regarding the cause of seizures.

We have to date tested over five hundred chemical compounds, and approximately seventy-five of these are capable of raising the convulsive threshold in animals to electrical stimulation to a significant degree. While most of these compounds have some similarity in their structural formula, no constant arrangement

of molecules has as yet been discerned. The effective anticonvulsants include derivatives of such various compounds as the phenyl ketones, the phenyl sulfones and sulfoxides, the barbiturates, the hydantoins, the benzoxazoles and the oxazolidinediones. The study is still in progress, and it is hoped that the results will throw further light on the problem.

Some of the compounds which were found to raise the convulsive threshold in animals have been used in the treatment of epilepsy in human beings. The best results have been obtained with diphenylhydantoin sodium, which was first reported in 1938. The good results which were reported with this drug have been confirmed by numerous investigators and have stimulated the search for other, and more effective, drugs. One of the compounds which has been introduced in the past few months is Tridione (3,5,5-trimethyloxazolidine-2,4-dione). The anticonvulsant activity of this drug in animals was first reported by Everett and Richards (*J. Pharmacol. & Exper. Therap.* **81**:402 [Aug.] 1944), and results of its use in human beings have been reported by Lennox, Thorne and De Jong. Experience with this drug has been limited, because its use has been restricted to several investigative clinics and only a few days ago was placed on the open market. The results reported to date indicate that its value is limited to the control of petit mal seizures. In our experience it has no value in the treatment of grand mal seizures, but our results in the limited trial that we have given it are in agreement with those of Lennox (The Petit Mal Epilepsies, *J. A. M. A.* **129**:1069 [Dec. 15] 1945) and indicate that it is the most efficient means of controlling petit mal seizures that has been discovered to date. We have not been able to confirm the statement of De Jong that Tridione is effective in controlling psychic equivalent or psychomotor seizures. A word of caution is necessary in regard to the use of Tridione. Patients who have both grand and petit mal seizures and are under treatment with an anticonvulsant drug, such as phenobarbital or diphenylhydantoin sodium, should continue to take that drug if Tridione is to be given, in order to prevent the occurrence of status epilepticus.

Representative case histories are presented here to illustrate the effect of Tridione.

CASE 1.—M. A. G., an 8 year old girl, had been subject to petit mal seizures since the age of 8 months. For the past several years the attacks had occurred at the rate of about thirty per day. The patient was mentally and physically normal. The electroencephalogram showed frequent bursts of 3 per second spike and dome waves, characteristic of petit mal epilepsy, and an attack could be precipitated regularly by a brief period of overventilation. Treatment with phenobarbital, 0.1 Gm. daily, and diphenylhydantoin sodium, 0.25 Gm. daily, or with Mebaral (n-methylethylphenylbarbituric acid), 0.2 Gm. daily, and glutamic acid, 4 Gm. daily, had no effect on the frequency of the seizures. Treatment with Tridione in a dose of 0.6 Gm. per day was started on Sept. 6, 1945, and there was a slight decrease in the frequency of the attacks. The dose of Tridione was increased to 0.9 Gm. daily on September 18, and the attacks were reduced to about one-half their former frequency. The child had an attack of grip in December 1945, and the drug was not given during the few days of the illness. There was an immediate recurrence of the attacks to their former frequency of thirty a day. The frequency was reduced to three or four attacks daily by administration of 0.9 Gm. of Tridione, and on Feb. 1, 1946 the dose of the drug was increased to 1.2 Gm. a day. There was an immediate cessation of attack, which had not recurred at the date of the last report, March 20, 1946.

CASE 2.—I. S., a boy aged 10, had one grand mal attack at the age of 4 years and three similar seizures in the year preceding our examination. Petit mal attacks had started at the age of 8, and for the last year they had occurred at the rate of twenty-five to fifty a day. The patient was mentally and physically normal. The electroencephalogram showed bursts of typical dome and spike waves with a frequency of 3 per second. Treatment with phenobarbital and glutamic acid or with Mebaral did not influence the frequency of the petit mal seizures. Treatment

with Tridione, 0.6 Gm., and Mebaral, 0.2 Gm., was started on Nov. 2, 1945. With this treatment, the petit mal attacks decreased to four or five a day, and the patient had a grand mal seizure on December 27. The treatment was changed to phenobarbital, 0.1 Gm., and Tridione, 0.9 Gm. The petit mal attacks were decreased to one in several days. The daily dose of Tridione was further increased to 1.2 Gm. on Jan. 26, 1946. No petit mal attacks had been noted up to the time of the patient's last report, on March 20, 1946.

CASE 3.—S. M., a 3½ year old girl, began at the age of 18 months to have attacks of "staring," lasting a few seconds. Grand mal seizures started at the age of 2 years. An electroencephalogram taken at this time at another hospital was read as diagnostic of petit mal epilepsy. The patient had been treated with phenobarbital, in doses varying from 0.03 to 0.25 Gm. daily, and glutamic acid, 13 Gm. daily, without any decrease in the number of attacks. When first seen by me, in July 1945, the child was mentally retarded. She talked very little and responded poorly to questions. She did not play with toys and was difficult to manage. She was extremely overactive, continuously climbing over the furniture in the home. At this time the attacks were occurring at the rate of five or six a day and were of the minor grand mal type. Treatment with diphenylhydantoin sodium, 0.2 Gm. a day, and phenobarbital, 0.1 Gm. a day, resulted in immediate cessation of the grand mal attacks and remarkable improvement in the child's behavior, but the patient began to have one or two minor attacks daily. In these attacks she would stare blankly and make a few movements of the head and arms. The entire attack lasted only a few seconds. Tridione was added to the previous medication, and the dose was gradually increased to 1.2 Gm. per day. The minor attacks have continued to occur at the rate of about two a day.

DISCUSSION

DR. H. T. WYCIS: I should like to ask Dr. Merritt whether he has had any experience with Tridione in the control of status epilepticus and whether he has any explanation of why in some cases the petit mal seizures cease on discontinuing the drug.

DR. MILTON K. MEYERS: I should like to ask the speaker whether he distinguishes between petit mal attacks in children and pyknolepsy. In the first case there were no grand mal seizures; yet there were at least thirty, and perhaps fifty, attacks a day of what seemed to be petit mal, and the child did well in school. The child with pyknolepsy, on the other hand, frequently has gradual relief from his seizures without any medication at all. I should like to know whether there is any difference in the electroencephalogram of pyknolepsy and that of petit mal and whether the first case which Dr. Merritt reported might not have been one of pyknolepsy.

DR. CHARLES RUPP JR.: If a patient is already receiving phenobarbital and is then given Tridione, should the phenobarbital be discontinued altogether, or should it continue to be given in conjunction with Tridione?

DR. H. HOUSTON MERRITT: In answer to Dr. Meyer's question, Mebaral is the 3-methyl derivative of phenobarbital. It is reputed to be less sedative than phenobarbital, but in our experience the results with the use of Mebaral have not differed from those with administration of phenobarbital.

Dr. Wycis asks about the use of Tridione for status epilepticus. Unfortunately, we have no information on this subject since we have not had the chance to use it with any patient in this state. Dr. Richards, who synthesized the compound, tells me it has been effective in several cases of status epilepticus.

Our experience would indicate that Tridione, when it is effective, only prevents the petit mal attacks and does not cure the underlying physiologic disturbance. The attacks have always returned in our patients when the medication was withdrawn.

In reply to Dr. Rupp's question regarding the use of other anticonvulsant medications with Tridione: If the patient has only petit mal seizures, it is safe

to discontinue previous forms of medication and use Tridione alone; but if the patient has grand mal as well as petit mal attacks, he should continue to receive whatever anticonvulsant medicine he has been given, in addition to the Tridione.

DR. FRANCIS M. FORSTER: I should like to ask Dr. Merritt whether he did not mean the status epilepticus of petit mal when he said that Tridione had been used successfully.

DR. H. HOUSTON MERRITT: No. Dr. Richards says that Tridione has been used to control status epilepticus of the grand mal type.

News and Comment

POSTGRADUATE COURSES OFFERED AT UNIVERSITY OF CALIFORNIA MEDICAL CENTER

The University of California Medical School, with the cooperative administration of University Extension, University of California, will shortly announce a program of postgraduate instruction to be offered at the Medical Center, San Francisco. A variety of courses will be given which will encompass the fields of internal medicine, general surgery, obstetrics and gynecology, otorhinolaryngology, ophthalmology, psychiatry and the basic sciences, as well as a course specially designed to meet the needs of general practitioners.

Fees for all these courses will be covered by the provisions of the G. I. Bill of Rights.

For further information with regard to these various programs of postgraduate instruction, kindly communicate with Stacy R. Mettier, M.D., Head of Postgraduate Instruction, Medical Extension, University of California Medical Center, San Francisco 22.

COURSE IN NEUROLOGY AND PSYCHIATRY, ILLINOIS NEUROPSYCHIATRIC INSTITUTE

The Illinois Neuropsychiatric Institute announces that its second three months' course in neurology and psychiatry will start on Monday, Feb. 24, 1947. This course is part of the regular basic training program for residents and fellows in the departments of psychiatry and neurology and neurologic surgery of the University of Illinois College of Medicine, and a limited number of qualified outside students will be accepted. The subjects included are: neuroanatomy; neuropathology and neuroroentgenology; electroencephalography; psychobiology, psychopathology and history of psychiatry, and psychoanalysis.

For information write to: Dr. Ben W. Lichtenstein, Illinois Neuropsychiatric Institute, 912 South Wood Street, Chicago 12.

Book Reviews

Psychoanalytic Therapy: Principles and Application. By Franz Alexander, M.D., and Thomas M. French, M.D., and associates. Price, $5. Pp. 353. New York: The Ronald Press Co., 1946.

For the past few years, members of the Institute for Psychoanalysis, Chicago, have individually reported material dealing with modifications of psychoanalytic therapy. In this book, Dr. Alexander and Dr. French, in collaboration with various members of the institute, present their findings. The material is discussed under two main headings. Part 1 deals with principles of psychoanalytic therapy and part 2 with the application of these principles. In the second part, case material is presented to illustrate the postulates of the authors. A greater flexibility in psychoanalytic therapy is the principal thesis of this book. The authors feel that many variations in technic not only may but should be adopted in certain situations. For instance, frequency of visits, which has usually been accepted as four to six times a week, may, according to these authors, at times be cut down as a therapeutic maneuver. The authors feel that frequency of interviews is in no way the determining factor of the depth of treatment. Cases are presented in which depth therapy is illustrated in patients who have been seen for relatively short periods.

The authors postulate that the transference relationship, as the dynamic aspect in the curative process, should be actively utilized by the analyst. This should be done not only through interpretation of the transference relationship but through actual intervention or playing down by the analyst. This can provide the patient with situations in which he will undergo new emotional experiences—"re-experiencing the old, unsettled conflict, but with a new ending, is the secret of every penetrating therapeutic result."

Ever since psychoanalysis has been established as a definite therapeutic procedure, attempts have been made to achieve the same results through short cuts. Some of these attempts have been rather disastrous and have done nothing more than dilute psychoanalysis. Other attempts have resulted in valuable contributions, which have been included in general psychotherapeutic and special psychoanalytic procedure.

In their contribution, the authors have widened their concept of psychoanalytic treatment. "Every therapy which increases the integrative functions of the ego (through re-exposing the patient under more favorable conditions to those conflicts which have before been met with neurotic defense mechanisms) should be called psychoanalytic, no matter whether its duration is for one or two interviews, for several weeks or months or for several years." Many analysts, of course, will take issue with this definition and feel that the authors in the main are applying psychoanalytic principles to psychotherapy and calling it psychoanalysis. Others, depending on their orientation, will agree with the authors.

One has the feeling that the authors set out with the objective of helping the patient, the means being secondary. Psychotherapeutic reports are most difficult to evaluate. So many variabilities enter into play, and the difficulties of adequate control make this field of psychiatry a most difficult one to evaluate scientifically. It will probably require many, many more years of work and study and more research than has been presented in this book to prove the authors' point one way or the other. Until then, depending on the psychotherapeutist's orientation, this book may be considered a start in the right direction or another of the experimental psychoanalytic deviations which have marked the tempestuous course of the development of psychoanalysis. The book is recommended.

Psychodrama. By J. L. Moreno, M.D. Volume 1. Price, $6. Pp. 424. New York: Beacon House, Inc., 1946.

This is volume 1 of a series of three volumes on psychodrama written by the creator of the art, Dr. J. L. Moreno. The other two volumes are in the process of publication. It is the first organized compilation of facts, figures, diagrams and theories explaining the basis for this form of therapeutics. Those who have seen Dr. Moreno in action wonder how he was capable of boiling down his explanation of psychodrama to three volumes. He has so much to say that, by his own admission, three volumes is but a compromise. If one considers the innumerable ramifications of his theory and practice, one can understand the enormousness of the task.

It is the function of psychodrama to record on a stage the drama of the patient's life in all its normal, neurotic or psychotic interrelations. Psychodrama, in contradistinction to the verbiage of psychoanalysis, uses the drama itself, with all its intrinsic settings, aids and other people (alter egos, directors and accessories). The patient acts out his neurosis, his delusions, his loves and hates, and hostilities, and even his hallucinations. Just what this does to the patient's problems is not clear. Catharsis is a very old mechanism and has been used in every form of psychiatric aid. Yet today one shies away from empiric psychiatry. The present day psychiatrist is interested in dynamics, and the author, in spite of criticism of the psychoanalytic method, does not lend enough scientific data to put him on solid ground.

There is no question in the mind of this reviewer that there is a functional niche in therapeutic psychiatry for psychodrama, but it is suspected that Dr. Moreno seeks more than a niche. His volume is a most ambitious piece of literature, in which he professes to have "the answer." One doubts it.

Laying a great deal of emphasis on "the spontaneity factor," he writes about it as though spontaneity could be found in the chromosomes and genes. He actually says so. Skepticism is a mild reaction to the speculation which he attempts to dress up as a science.

To psychiatrists familiar with psychodrama and to those who have used psychodrama as "another instrument" of psychotherapy, the formulations of this volume may be meaningful. However, I should hesitate to recommend this volume to those who are but vaguely familiar with the theory and practice of psychodrama. The formulations are too speculative and vague. Some of the author's statements are so foreign to the scientific way of thinking that they are actually incomprehensible. This book is recommended to Moreno's disciples.